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# **The Renewable Energy Trust Fund:**

## **Progress, Challenges, and Opportunities**



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This report is being submitted by the  
Massachusetts Technology Park Corporation ("MTPC")  
as required by Section 20(b) of Chapter 25 of the  
General Laws of the Commonwealth of Massachusetts.



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## 1 Message from the MTPC Executive Director and Board Chairman

In creating and funding the Renewable Energy Trust Fund (RET), the Massachusetts Legislature directed MTC to leverage RET assets to generate the maximum public benefits from renewable energy over time to the citizens of the Commonwealth. These public benefits are to be measured principally by increases in the amount of renewable energy generated and consumed in Massachusetts but also by an expansion in the economic activity associated with the Commonwealth's cluster of renewable energy and related firms and enterprises.

To secure maximum leverage from the RET, MTC has invested considerable time, effort and resources to develop programs that advance renewable energy applications that are sustainable by the marketplace over the long term while generating the most direct and immediate returns to the citizens of Massachusetts.

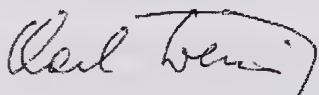
A current example of such an initiative is the Green Schools program, which supports a significant long-term market opportunity in Green Buildings while generating near-term benefits to Massachusetts citizens through both the current construction of high-performance, healthier school buildings with lower operating and social costs and the application of lessons learned to future school building design and construction throughout the Commonwealth.

Additional similar efforts to be announced in the near future include:

- an affordable housing component to the Green Buildings program;
- a program to use fuel cells and other renewable energy technologies to advance a legitimate market opportunity for premium power while supporting immediate and critical needs relative to public security and safety in the wake of the terrorist attacks of September 11, 2001; and
- a central power generation financing program for large scale wind and related projects that supports the Green Power market and addresses the heightened public interest in energy supply diversity.

In so structuring the RET's programs, we have adhered to our legislative mandate and the best interests of the RET's beneficiaries. We have determined to avoid wholesale applications of the fund for short term or marginal results. We have stressed careful planning and research, thoughtful program design, and a patient approach that seeks to identify market opportunities and address market barriers. We very much appreciate the support we have received from the Legislature and the patience they have accorded our efforts. With this backing, our detailed planning and our investments to date have positioned the RET to generate the maximum benefits to the citizens of Massachusetts in the years ahead.

Sincerely,



Dr. Karl Weiss  
Chairman, MTPC Board of Directors



Mitchell L. Adams  
Executive Director, MTPC





## 2 Executive Summary

As administrator of the Renewable Energy Trust (RET) since its inception in 1997, the Massachusetts Technology Collaborative (MTC) has carried out its legislative mandate to foster an increased supply and use of renewable energy resources while protecting the environment and providing distinct public benefits to the Commonwealth's citizens. Systematic examination of a variety of approaches to renewable energy sources and careful planning have set the stage for a number of programmatic initiatives, many of which have already been successfully implemented.

To date, a series of programs totaling \$110.0 million have been launched from which almost \$60 million in grants, loans and contracts have been awarded. Exemplary among these efforts is the Waste-to-Energy Program whereby 138 communities throughout Massachusetts were awarded \$54 million to help defray expenses associated with adherence to the 1990 Clean Air Act Amendments.

Five other major initiatives include:

**The Premium Power Program**, which explores and promotes the use of fuel cells as sources of highly reliable power. Awards for planning activities (\$354,000) and installation projects (\$1.9 million) have been made to five organizations. Future activities in this area will include applications in support of critical public security and safety needs generated in the wake of the September 11<sup>th</sup> terrorist attacks.

**The Green Buildings Program**, which promotes the joint use of energy efficiency and renewable energy technologies in public and private buildings throughout the Commonwealth. The first activity in this area is the Green Schools initiative, a \$13.5 million collaborative effort between MTC and the Massachusetts Department of Education's School Building Assistance Program targeted at the state's public schools. This initiative is to be followed in short order by an affordable housing green buildings project and other green buildings activities.

**The Consumer Aggregation Program**, which seeks to support collective electricity purchasing consortia and harness their latent demand for power from renewable energy sources, has to date awarded \$850,000 to nine groups.

**The Green Power Pre-Development Program**, which addresses the addition of power from renewable energy sources such as wind, biomass, landfill gas and photovoltaic technology to New England's power distribution grid. Awards totaling \$745,000 have been made for pre-development activities in this area with a total potential to support the development of up to 50 MW of green power.

**The Solar-to-Market Program**, a \$10.0 million commitment to support the development of the Commonwealth's solar energy cluster through innovative applications of solar generation technologies and related work to identify and address market barriers to increased use of these technologies in the Commonwealth.

Throughout this period, outreach activities that included the dissemination of information about renewable energy through seminars, conferences and publications, and several sponsored studies were prominent features of MTC's efforts. The appended map displays the many communities in Massachusetts that have benefited from RET support to date.

The RET's operations are solidly anchored in a set of principles which stress the importance of consumer choice, collaboration with stakeholders and members of the public in the design of





programs, a systematic review of applications for support by independent panels to ensure fairness, and learning about viable renewable energy products and markets by experimentation. The formulation of the RET's Strategic Direction Statement that includes these principles and its initial operating plan were the first tasks completed after initiation of full operations in April 2000. Since this full start, which was delayed while a constitutional challenge to the RET's funding mechanism was favorably resolved, MTC created the infrastructure (governance, management, personnel and financial systems) that enables the RET to function effectively.

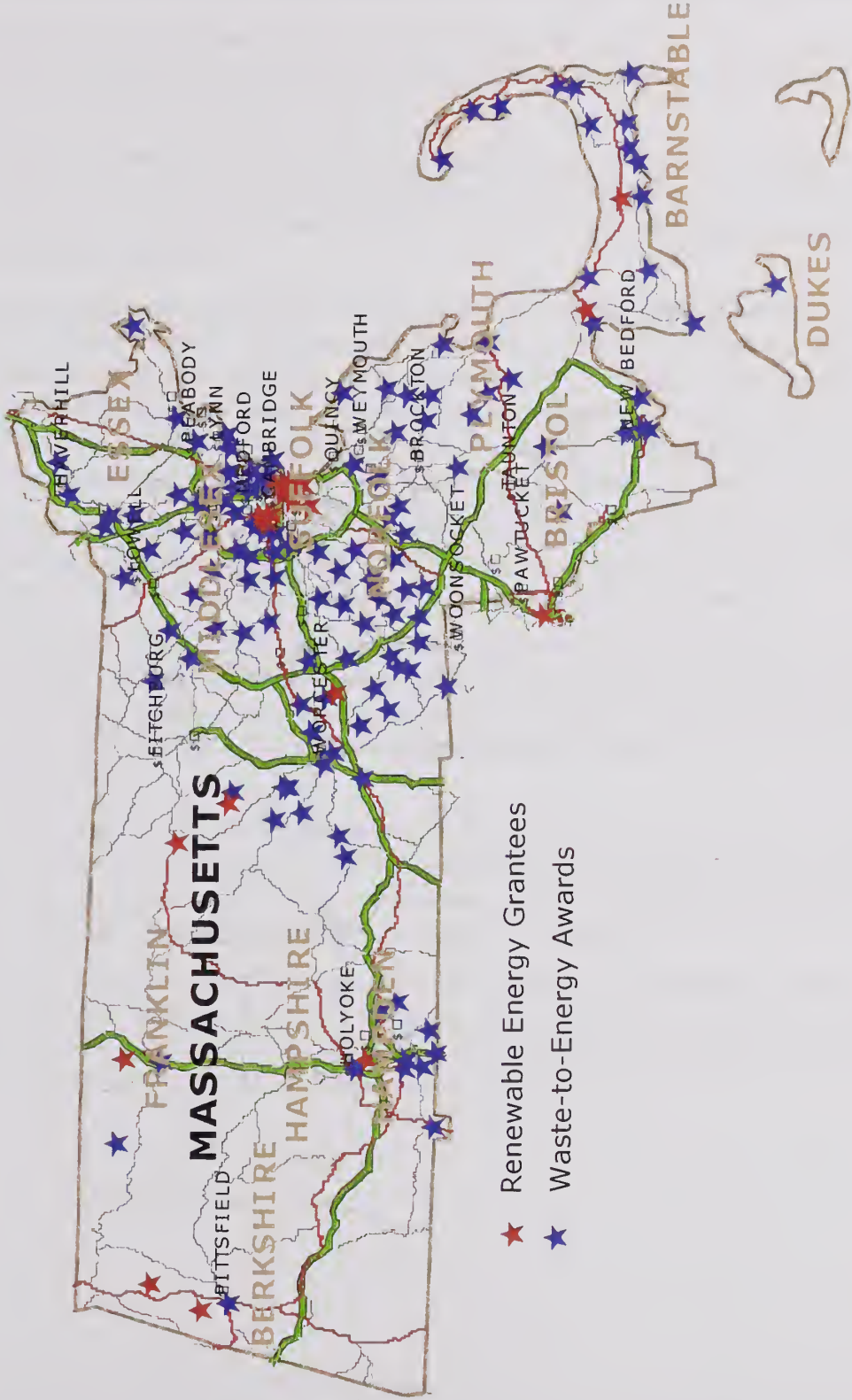
In the years ahead, the RET's thrusts will be guided by the basic strategy articulated in November 2000. Accordingly, the planned activities will continue to stress the exploration of sustainable markets for renewable energy in Massachusetts, support further consumer aggregation projects, promote renewable energy technologies in distributed generation and facilitate the growth of the Commonwealth's emerging renewable energy industry cluster. New programs will include innovative financing initiatives for renewable energy generation projects, the exploration of tradable renewable energy certificate concepts, installation projects for photovoltaic systems, programs to provide business services and development financing for fledgling renewable energy companies, and the facilitation of cooperative renewable energy research by industry and universities.

The RET's financial situation is sound. Since its inception, the \$168.84 million that have been received from the renewable energy surcharge have increased to \$182.04 million through the investment of unexpended funds. Awards and expenditures to date amount to \$72.08 million. This sum is comprised of \$59.47 million for project grants, contracts, loans, studies and seminars/conferences; \$4.55 million for RET personnel and direct expenses; \$3.93 million for allocated general management and administrative expenses; \$3.45 million for start-up costs for program development; and \$690,000 for capital items. The \$110 million of uncommitted funds as of December 31, 2001, when combined with \$127 million anticipated to be received from the renewable energy surcharge by the end of 2006 and projected interest through that period of approximately \$19 million, will provide the resources necessary to support the RET's initiatives over the course of this five-year period.

A coherent strategy based on sound principles has enabled the RET to achieve some impressive successes. Building on these accomplishments, the RET is poised to move Massachusetts into a future in which renewable energy plays a significant role.



RET Awards by Municipality





### 3 Principles for RET Investments and Operations

The principles summarized below provide the framework for the RET's policies, procedures and operations. They constitute a key component of the *Statement of Strategic Direction* approved by the MTC Board of Directors on November 1, 2000.

- **RET investments should build on consumer choice as reflected in a willingness to pay for electricity generated from renewable resources.** MTC believes that the willingness of some consumers to pay more for renewable energy is an important aspect of potentially viable renewable energy markets.
- **Ongoing subsidies for renewable energy should be clearly justified and used only to further the public interest.** Some benefits afforded by renewable energy – air quality improvements, energy diversification, and broad economic advances – are essentially public goods whose value is *not* reflected in the market.<sup>1</sup> Underwriting the cost of renewable energy to achieve MTC's legislative mandate is acceptable if a long-term commitment to such support is based on a clear rationale and it has the broad backing of diverse groups in the Commonwealth.
- **RET resources should be leveraged with investments by other private and public organizations.** Financial leverage will extend the impact of the RET and ensure a strong commitment to specific projects and the broader goals of the Restructuring Act.
- **RET investments should be subject to systematic review based on explicit criteria.** Formal, transparent processes must govern the use of RET funds to ensure fairness to stakeholders and, ultimately, proper accountability to the citizens of the Commonwealth. RET expenditures should be subject to systematic review based on explicit criteria and a formal approval process.
- **MTC should collaborate with stakeholders in designing and implementing specific initiatives undertaken through the RET.** Collaboration with all stakeholders is essential to ensure the success of renewable energy programs, given the complexity of issues and the evolving nature of energy markets in Massachusetts and elsewhere.
- **MTC should emphasize learning by doing.** No one knows precisely how markets for electricity from renewable sources will evolve and grow. Consequently, the task of stimulating the supply of and power from renewable energy sources calls for creativity and experimentation with a diverse set of programs that probe realistic options.

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<sup>1</sup> Public goods have two unique properties: First, consumption of a public good by one consumer does not affect the ability of other consumers to benefit from it (*non-rivalry*). Second, it is impossible to stop people from benefiting from the good even if they are unwilling to pay for it (*non-excludability*). The benefits ascribed to renewable energy meet both of these conditions. For the most part, customers that pay a premium for renewable energy receive the same benefits as every other consumer (and non-consumer). Customers that decide to pay a premium for renewable energy do enjoy, however, the additional satisfaction of contributing directly to broader public interests.

# THE HISTORY OF THE UNITED STATES

OF THE UNITED STATES OF AMERICA

FROM THE FIRST SETTLEMENTS TO THE PRESENT TIME

BY JAMES M. SMITH

NEW YORK: PUBLISHED BY J. B. LIPPINCOTT & CO.

1880

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## 4 Accomplishments

### 4.1 Overview

The Electric Utility Restructuring Act of 1997 provides for a charge on each kilowatt-hour of electricity purchased by consumers in competitive service territories to support a broad range of activities related to renewable energy.<sup>2</sup> The charge varies over time according to the following schedule:

	1998	1999	2000	2001	2002	Beyond 2002
Renewable energy charge (¢/KWH)	0.075	0.100	0.125	0.100	0.075	0.050

The renewable energy charge is collected by distribution companies and transferred in whole to the Massachusetts Technology Park Corporation (MTPC) specifically for the Renewable Energy Trust Fund (RET). A small charge imposed on electricity sales – roughly 50 cents per month, declining to 38 cents per month in 2002 and beyond, for the typical residential customer created a fund that is used to help realize broad environmental and economic goals established by the Legislature. As of December 31, 2001, the charge had generated almost \$169 million and is expected to yield a total of \$202 million by the end of 2002. Of this amount, roughly \$54 million is earmarked specifically for waste to energy projects in the Commonwealth.<sup>3</sup>

While the waste-to-energy and renewable energy programs arise from the same legislation, they are distinct activities motivated by different interests. The first is a one-time measure intended as a means to help communities in the Commonwealth deal with rising waste disposal costs brought about stricter environmental regulations. This funding also recognizes waste-to-energy as a contributor to fuel diversity in the Commonwealth. The purpose of the latter is to advance the prospects of solar, wind, biomass and other renewable resources to help meet energy requirements in the Commonwealth and elsewhere.

### 4.2 Waste-to-Energy Program

As noted above, the Restructuring Act set aside a portion of the RET proceeds to help communities that are tied into long-term contracts with waste-to-energy facilities deal with the resulting financial burden. Over one-third of the communities in the Commonwealth have entered into long-term contracts with waste-to-energy facilities over the past few decades. These facilities have installed additional pollution control equipment and adopted new operational procedures to comply with heightened air quality standards related to emissions of certain criteria pollutants, including carbon monoxide, nitrogen dioxide, sulfur dioxide, volatile organic compounds, lead, and particulate matter established under the Clean Air Act Amendments of 1990 ("CAAA"). Under the provisions of existing contracts, waste-to-energy facilities passed on resulting higher waste disposal costs to Massachusetts communities.

MTPC commissioned a background study on waste-to-energy regulations and contractual issues and began outreach with affected communities during the pendency of the lawsuit challenging the constitutionality of the RET funding mechanism. Early research findings revealed that potential

<sup>2</sup> The charge only applies to customers in competitive service territories, including customers of Municipal Lighting Plants that have elected to open their service territories to competition or that supply generation services outside their service territories.

<sup>3</sup> The revenues derived from one-quarter of one mill (\$0.00025) of the total Fund charge collected from March 1, 1998, through December 31, 2002, are being set aside to fund the Waste-to-Energy Program.



waste-to-energy claims could substantially exceed the available funding. Communities faced with mounting fiscal pressures requested that MTPC move expeditiously to fulfill the statutory mandate. MTPC chose to directly engage stakeholder communities by facilitating an intensive collaborative process during the late Summer and Fall of 2000 that was open to all interested parties. This collaborative forum provided a neutral venue to research, analyze, and resolve critical public policy, statutory, legal, and technical issues.<sup>4</sup>

MTPC provided the stakeholders with independent research to ensure that any resulting recommendations were supported by the facts and the law. Achieving consensus among diverse stakeholders on guidelines for administering the funding program offered an equitable resolution that appears to have avoided a protracted fight in the courts or the Legislature. As a direct result of this collaborative process, MTPC's Board of Directors adopted a fair, transparent and systematic process for allocating available funds to affected communities<sup>5</sup> that incorporated the primary consensus recommendations of cities and towns throughout Massachusetts that were represented in the collaborative process.

MTPC announced almost \$54 million in grants to 138 Massachusetts communities (including Otis Air National Guard Base) on March 26, 2001. Most of the grant monies awarded by MTPC serve to reimburse communities for a portion of their share of the capital costs associated with the installation of pollution control equipment. However, some funds are also being made available to assist communities with costs related to facility closures as well as prior capital investments that, in effect, reduced current compliance costs.

Approximately 40 percent of the committed funds were disbursed in 2001; the balance will be released in two installments in February 2002 and February 2003.<sup>6</sup> MTPC has committed funds and adopted program guidelines that permit communities to draw down on the monies as their contractual obligations arise. Some communities will be reimbursed for eligible contractual expenses over the lifetime of contracts that extend out as far as 2016. Other communities have opted for lump sum payments, using the leverage afforded by RET funding to negotiate a reduction in contract costs.

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<sup>4</sup> The language of the waste-to-energy provisions of the Renewable Energy Trust Fund afforded MTPC a significant amount of discretion in implementing its directive. Differing interpretations of the provisions by interested parties threatened to delay or impeded MTPC's goal to award grants in a timely but prudent manner. For example, although the provisions were generally understood to apply primarily to municipal contractual obligations arising from the cost to the waste-to-energy facilities of compliance with the requirements of the CAAA, these environmental standards were not expressly mentioned in the statutory language. Further, MTPC is directed "to provide debt service assistance" to municipalities in conjunction with their contractual obligations associated with the "installation of pollution control technology at those waste-to-energy facilities. MTPC's investigation revealed that there was little debt issued, either by the waste-to-energy facilities themselves or by the contractually bound municipalities, in connection with compliance with the CAAA. MTPC ultimately concluded that it was consistent with the language of the Waste-to-Energy provisions to make grants from the RET to reimburse municipalities for contractual obligations related to the CAAA or its precursor statute, bounded and limited, however, by the amounts of debt previously issued by the owners of the waste-to-energy facilities for related pollution control technology improvements. MTPC's programmatic findings and determinations were supported by an opinion letter issued by the law firm of Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C.

<sup>5</sup> To be eligible for a grant, an applicant must be a municipality or a governmental body with a long-term, waste disposal contract with a waste-to-energy facility located in the Commonwealth that was in effect on November 25, 1997, subject to limited exceptions regarding the timing of the contract. There are seven waste-to-energy facilities currently operating in Massachusetts. These are located in Agawam, Haverhill, Millbury, North Andover, Pittsfield, Rochester, and Saugus. An eighth facility in Lawrence closed in 1998. The contract must permit the facility owner/operator to recover environmental compliance costs from the contracting community.

<sup>6</sup> Under the terms of the governing statute, Section 4E(f)(2) of Chapter 40J of the General Laws, MTPC is limited in how quickly it can disburse waste-to-energy money from the Fund. More specifically, the statute essentially requires a minimum of three annual payments to eligible municipalities ("such grants shall not exceed, in the aggregate, in any calendar year prior to calendar year 2003 the amount segregated in the fund pursuant to this paragraph in the calendar year previous thereto.").

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FROM 1800 TO 1860

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### 4.3 Renewable Energy

The Electric Utility Restructuring Act specified the purposes of the RET in terms of broad environmental and economic goals. In keeping with these goals, the Strategic Direction Statement and Detailed Operating Plan for the RET outlined four specific objectives:

- Shift electric energy consumption in Massachusetts away from conventional energy resources to a greater reliance on energy generated from renewable resources;
- Increase electric generating capacity from renewable resources to meet the growing energy demands of consumers in Massachusetts while also encouraging the adoption of energy efficiency measures;
- Expand and support the development of a renewable energy cluster in Massachusetts, including system developers, system integrators, manufacturers, equipment vendors, architects and engineers, service providers, and research organizations; and
- Increase the overall level of economic activity related to renewable energy in the Commonwealth.

To realize these objectives, MTPC has endeavored to strike an appropriate balance between achieving immediate impacts and establishing the necessary foundation for sustainable renewable energy markets over the longer term.

There are two principal ways in which MTPC seeks to advance the public purpose. The most significant in terms of RET expenditures is through a series of funding programs that provide grants and loans for renewable energy projects. As envisioned in the legislation, MTPC has also established programs for generating and disseminating information of direct relevance to project developers, ratepayers and the broader renewable energy community. These activities include sponsored studies addressing issues critical to the advancement of renewable energy as well as seminars and conferences designed for different audiences. They form an integral part of the strategy to achieve stated objectives for the RET.

#### 4.3.1 RET funding programs

MTPC has established a series of funding programs that involve formal solicitations whereby eligible organizations are invited to submit applications according to clear guidelines. MTPC staff and independent review panels evaluate all applications based on explicit criteria provided in the solicitations. All awards are subject to final approval by the MTPC Board of Directors.

All award recipients are required to submit progress reports (in addition to other deliverables) as defined in their contracts as a condition for grant or loan disbursements. Recipients are also expected to cooperate in the preparation of in-depth case studies following the completion of the project. These case studies will describe the major elements of the project, present technical performance data, document costs and benefits, and highlight critical lessons that can be applied to similar projects in the future. Case studies will be disseminated widely as part of ongoing information programs and other market development efforts.

To date, MTPC has released a series of formal solicitations for proposals:

- **Consumer aggregation.** While the Restructuring Act enables consumer choice there are, in fact, no retail electricity suppliers currently operating in the Commonwealth that provide





ratepayers with the option of purchasing energy from renewable sources.<sup>7</sup> Currently, ratepayers can only purchase an undifferentiated power product, a small portion of which may include power generated from renewable sources, primarily hydroelectric power. There are indications that a segment of the population may be willing to pay more for energy from renewable sources. The aim of the consumer aggregation program is to harness the latent demand for green power among consumers in the Commonwealth and permit ratepayer groups to establish power purchasing agreements directly with renewable energy generators or through other intermediaries. This initiative enables grant recipients to use their collective buying power to ensure that a portion of the electricity they use is generated from renewable resources. Given the absence of retail electricity suppliers, this approach is likely to be more effective in boosting demand for energy from renewable resources than mass advertising campaigns directed toward the public at large, particularly in the near term. It is expected that consumer aggregations will help stimulate the establishment of a sustainable markets for renewable energy over time.

MTPC invited proposals from not-for-profit organizations and municipalities to create consumer aggregations organized on a geographic or sector basis. Projects must be aimed at increasing demand for electricity generated from renewable energy resources among a defined group of residential, commercial and/or industrial electric customers in Massachusetts to be eligible for funding. Project activities include outreach efforts among defined groups, assessing demand for electricity generated from renewable sources among potential members of the aggregation, defining the attributes of the green power product and/or renewable energy technologies<sup>8</sup> for which members are willing to pay, initiating discussions with potential suppliers, and establishing marketing, purchasing and administrative mechanisms.

MTPC received 12 proposals for funding in response to the solicitation. After extensive review, awards amounting to \$850,000 in total were approved for nine consumer aggregation projects. These projects include groups from community organizations, faith-based groups, not-for-profit energy service companies and municipal governments.

- **Renewable energy generation for green power.** With the exception of hydroelectric facilities, the total capacity of renewable energy generating plants in New England is limited. Changes in the ownership of generating plants brought about by the Restructuring Act, the continued weakness of competitive markets, relatively low wholesale electricity prices, and a movement away from long-term power purchasing agreements have all dampened new investment in renewable energy generating plants over the past three years. In addition, some projects continue to face significant problems related to land disposition, siting and permitting.

MTPC has been working with developers and community representatives to address barriers to potential projects and encourage the development of *new* renewable energy generating facilities in the region. A solicitation invited developers to submit applications for funding needed for pre-

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<sup>7</sup> At this point, there are only a few retail electricity suppliers offering green power products in the United States. Moreover, these suppliers are limited to markets in California, Connecticut, New Jersey, Pennsylvania and Texas. In the case of California, given the suspension of competitive markets, suppliers are not allowed to take on new customers. Leaving aside California, it is estimated that less than 60,000 consumers have opted to purchase green power from competitive retail electricity suppliers in the United States.

<sup>8</sup> The RET Enabling Act defines renewable energy technologies eligible for assistance as follows: "...solar photovoltaic and solar thermal electric energy; ocean thermal, wave or tidal energy; fuel cells; landfill gas; waste-to-energy which is a component of conventional municipal solid waste technology in commercial use; naturally flowing water and hydroelectric; low emission, advanced biomass power conversion technologies, such as gasification using such biomass fuels as wood, agricultural, or food wastes, energy crops, biogas, biodiesel, or organic refuse-derived fuel; and storage and conversion technologies connected to qualifying generation projects; provided, however, that expenditures related to waste-to-energy projects or facilities shall be limited to funds segregated pursuant to paragraph (2). (Section 4E(f)(1) of Chapter 40J of the Massachusetts General Laws.)

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development activities of grid-connected generating facilities with a minimum capacity of one megawatt. Activities eligible for funding include identifying sites, assessing available renewable energy resources, assessing environmental impacts, obtaining permits and approvals, undertaking design and engineering work, assessing technical and financial feasibility, planning electrical interconnections, securing land use agreements, gauging community support and identifying ways to address public concerns.

Funding is structured as a loan if the applicant is a for-profit entity or as grant if the applicant is a not-for-profit, quasi-public corporation or public authority. Loans to for-profit entities may not exceed 50 percent of the total cost of the project on a cash basis. Not-for-profit organizations are required to cover at least 25 percent of the total cost of the project on a cash basis. Quasi-public corporations and public agencies are not subject to the cost-sharing requirement. In general, the maximum award that an applicant can receive for predevelopment activities related to an individual site is \$150,000.

MTPC has awarded a total of approximately \$745,000 for pre-development activities. These have spanned a wide range of projects, including wind, biomass, landfill gas and photovoltaic generating plants. Ultimately, these projects could add more than 50MW of renewable energy generating capacity to the NEPOOL power grid.

- **Premium power in distributed generation.** While most users consider cost to be the most important criterion affecting their purchasing decision, certain segments of the market are more concerned with the reliability of power, seeking to minimize power disruptions. Renewable energy technologies, particularly fuel cells, can enhance the reliability of electricity in distributed generation applications. Such premium power systems are expected to benefit end-users directly by reducing critical health and safety risks, and financial, economic and other losses that stem from power disruptions. Companies and institutions are likely to invest in these systems once hard evidence of their reliability is readily available. Potential sites include data centers, transaction processing centers, telecommunication facilities, research laboratories, manufacturing plants, airports, and hospitals.

MTPC has issued two solicitations to explore and promote the use of fuel cells to provide highly reliable power. One solicitation enables companies, not-for-profit organizations, quasi-public corporations and government agencies to examine the feasibility of using fuel cells in premium power applications. Eligible project activities include assessing current power quality, identifying potential losses resulting from power disruptions, defining power requirements, preparing conceptual designs, analyzing the financial feasibility of alternative systems, and developing bid documents. The maximum award that an applicant can receive for an individual project is \$150,000. Private companies and not-for-profit organizations are required to contribute 10 percent of the total cost of the project in cash. Cost-sharing may include funding from federal, other state or private organizations.

The second solicitation makes funds available to help organizations defray the cost of installing fuel cells in stationary, high quality power systems. In this case, the fuel cell-based premium power system must be designed to ensure higher availability than afforded by the local utility. The proposed system can employ commercially available or prototype fuel cells. Preference is given to installations that utilize waste heat from the systems to reduce the overall emissions profile of the operation. The maximum award for an individual project is \$2,000,000, subject to the requirement that the applicant contributes at least 75 percent of the total costs of the project.





Funding is available to defray the capital costs of the fuel cell power plants, flywheels, power electronics, necessary building improvements, and associated engineering services.

Award recipients are required to monitor and report on the performance of the fuel cell systems, thereby generating hard data on the technical performance and the total cost of producing power with fuel cells that MTPC can disseminate.

As of December 31, 2001, MTPC had awarded a total of \$354,000 for planning grants, and \$1.9 million for the installation of fuel cell-based systems.

- **Green schools and green buildings.** With about one-third of all energy consumed in the U.S. being used for heating, cooling, lighting and appliances in buildings, considerable attention has been focused over the past three decades on enhancing energy efficiency within homes, offices, schools, hospitals and other buildings. Energy efficiency measures include elements such as passive solar design, tight construction, natural lighting and ventilation, improved landscaping, insulation, high performance windows and doors, as well as energy efficient heating and cooling systems, appliances and light fixtures. These approaches have been successful in reducing energy consumption at a relatively low cost. Recently, a more comprehensive view of the environmental impact of buildings has led to the promotion of pollution prevention, waste minimization, water conservation, and the greater use of natural and recycled materials. The "Green Building" concept also includes the incorporation of renewable energy technologies into buildings, particularly PV systems. Green building practices that encompass renewable energy technologies are best considered at the start of the building design phase.

MTPC has provided funding for or otherwise supported design work at a number of public use-oriented projects to explore green building practices. These sites include the New England Aquarium and the Boston Convention and Exhibition Center. This experience prompted MTPC to launch a more aggressive campaign for the adoption of green building practices in public buildings, focusing initially on elementary and secondary schools. In October 2001, the establishment of the Massachusetts Green Schools Program was announced. This \$13.5 million initiative is structured to promote greater energy efficiency and use of renewable energy technologies in schools throughout the Commonwealth. It is a cooperative effort between MTPC and the Massachusetts Department of Education (DOE) School Building Assistance (SBA) Program.<sup>9</sup>

This pilot effort will provide up to \$130,000 to school districts to help defray pre-construction planning and design costs, and up to \$500,000 for construction, commissioning, and performance monitoring costs associated with the installation of renewable energy technologies and enhanced energy efficiency measures. To augment funding provided by MTPC, DOE has agreed to add two percentage points to the calculation of the state reimbursement rate for school facilities.

The first round of this competition made awards totaling \$1.3 million for design assistance to ten school districts in January 2002. MTPC has encumbered an additional \$5,000,000 to provide construction assistance for the ten school districts, pending successful completion of the design phase of each project. All of these green schools are expected to be built over the next three years. The next round is scheduled for the early fall of this year.

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<sup>9</sup> The Massachusetts Department of Education oversees the School Building Assistance Program. Since its creation in 1948, the program has provided municipalities with financial assistance for the construction and financing of school projects.





- **Solar Energy Business Association of New England.** The solar industry has made great strides over the past 20 years and continues to expand in the Commonwealth as demand for these technologies increases in domestic and global markets. There are significant barriers to exploiting the full potential of this promising technology, including high capital costs and various institutional and regulatory constraints. Numerous discussions with representatives of the solar industry on the best way to encourage greater use of solar technologies (specifically photovoltaic systems) and promote the growth of this industry cluster in the Commonwealth culminated in MTC's agreement to support the establishment of a professionally managed association for the region's solar energy industry. In February 2001, the MTPC Board of Directors approved a grant of \$400,000 to the Solar Energy Business Association of New England (SEBANE). These funds will be used to support the initiation and operations of the industry association, including their participation in regulatory proceedings at NEPOOL, DOER, and DTE, and the involvement of SEBANE in the development of the RET Solar-to-Market Initiative.

The Solar-to-Market Initiative is intended to develop programs that will expand the production and use of solar technologies consistent with the goals of the Restructuring Act and the principles articulated in the *Statement of Strategic Direction*. SEBANE, MTPC and other stakeholders have been working over the past eight months to formulate a comprehensive plan, which is expected to be submitted to the MTPC Board of Directors in March 2002. With the Board's approval, up to \$10 million will be committed to programs under this Initiative.

#### **4.3.2 RET research and outreach**

The RET is much more than a source for project funding. MTPC considers the generation and dissemination of objective information that can influence the actions of various members of the renewable energy community to be a central function of the RET. Accordingly, the organization has undertaken a number of major studies on critical issues related to renewable energy including those summarized below.

- **Assessment of renewable energy technologies and markets.** This effort involved examining different renewable energy technologies and markets. In October 1998, MTPC published a study entitled, "*Profiles of Leading Renewable Energy Technologies*" in collaboration with Arthur D. Little, Inc. This report, which provided a comprehensive assessment of the renewable technologies eligible for investment by the Renewable Energy Trust, included factors such as cost and performance characteristics, forecasts of future technology and market trends, identification of key applications and markets, estimation of the broadly-defined market potential in the region, definition of technical and market barriers, and identification of relevant federal programs. Recently, MTPC initiated an intensive study of the current status and prospects for photovoltaic systems and explored the potential for using fuel cells to provide highly reliable power at public safety facilities throughout the Commonwealth.
- **New England wind study.** In partnership with the Connecticut Clean Energy Fund and Northeast Utilities Service Company, MTPC is conducting an assessment of wind resources in New England, including offshore areas. The first phase of the project focusing on southern New England is scheduled for completion in February 2002. The second phase, which will focus on northern New England, is projected to be completed by the end of 2002. It is expected that the study will provide valuable information that will enable developers to identify suitable areas for wind turbines and prepare preliminary estimates of energy generation at alternative sites in the region.

The first part of the document discusses the importance of maintaining accurate records of all transactions and the role of the accounting department in ensuring the integrity of the financial statements. It also highlights the need for regular audits and the importance of transparency in financial reporting.

The second part of the document provides a detailed overview of the company's financial performance over the past year, including a breakdown of revenue, expenses, and profit. It also includes a comparison of the company's performance to industry benchmarks and a discussion of the factors that have contributed to the company's success.

The third part of the document outlines the company's financial strategy for the upcoming year, including plans for increasing revenue, reducing expenses, and improving overall financial performance. It also discusses the company's approach to risk management and the importance of maintaining a strong financial position.

The fourth part of the document provides a summary of the key findings from the financial review and offers recommendations for improving the company's financial performance. It also includes a discussion of the company's overall financial health and the importance of continued monitoring and reporting.

The fifth part of the document provides a detailed analysis of the company's financial data, including a breakdown of revenue by product line and a comparison of the company's performance to industry benchmarks. It also includes a discussion of the factors that have contributed to the company's success and the importance of maintaining a strong financial position.

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- **New England wave energy study.** In conjunction with the Connecticut Clean Energy Fund, MTPC sponsored a preliminary study on the potential for capturing wave energy in near-shore and offshore locations in southern New England. The study estimated the annual average significant wave height, 20-year maximum significant wave height, annual average wave energy flux, and a wave energy development index for 36 grid points in the latitude band between 40°N to 44°N. The study was completed in March 2001 and has been published on various websites and presented at conferences.
- **IRS ruling on treating green power premiums as a charitable contribution.** In its Strategic Direction Statement, MTPC committed to requesting a ruling from the United States Internal Revenue Service that Green Power Premiums – the additional amounts paid by consumers for renewable power delivered to the power grid over the price of the undifferentiated power alternative – were eligible for treatment as tax deductible charitable contributions under Internal Revenue Code Section 170(c)(1).<sup>10</sup> MTPC filed its Private Letter Ruling Request on January 27, 2001. MTPC advanced the argument that the payment of a Green Power Premium was essentially a charitable act that had been determined under Massachusetts law to be a public purpose activity. MTPC advanced, further, that a simple change in the method of accounting for Green Power Premiums – from the legacy utility accounting methodology where such premiums were treated as applied for the consumer's personal account to a more accurate characterization of such payments as constructively made to the Commonwealth for the public benefit – would make the premium payments eligible for qualification as tax deductible charitable contributions to the State.<sup>11</sup> The Internal Revenue Service accepted MTPC's arguments in a Private Letter Ruling dated July 3, 2001.<sup>12</sup> This ruling may constitute a significant component of a long-term sustainable Green Power strategy. Its use could substantially reduce the cost of Green Power Premiums to individual consumers, by up to 45% in the case of consumers in the highest marginal tax brackets.<sup>13</sup> MTPC plans on working with consumer aggregations and electricity suppliers in the Commonwealth to take full advantage of this favorable tax ruling.

MTPC has sponsored or actively participated in numerous seminars and conferences concerning renewable energy. These events, which have attracted hundreds of participants, include the following:

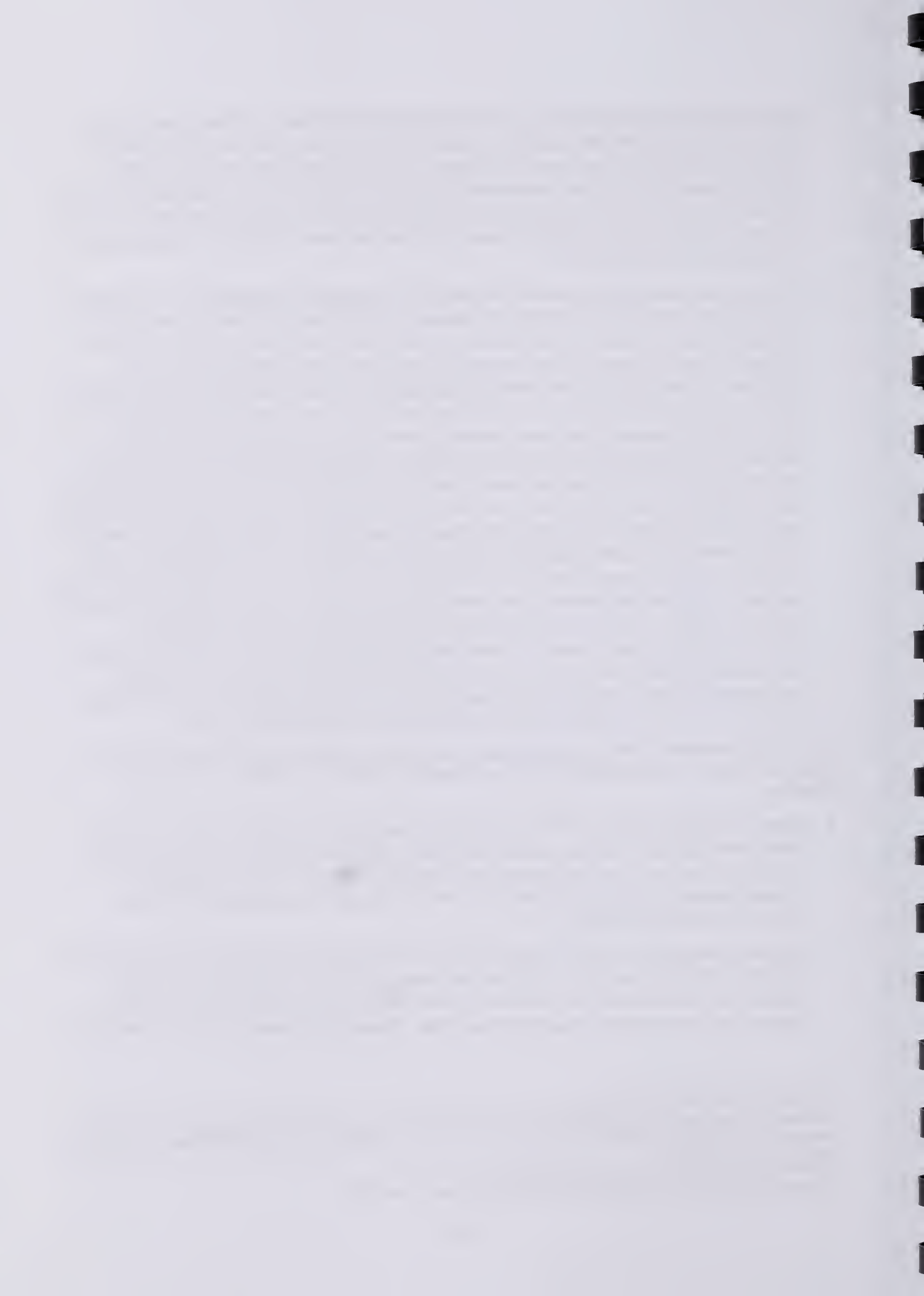
- **Biomass Working Group.** MTPC has actively encouraged the establishment of a Biomass Energy Working Group consisting of representatives of federal, state and non-governmental organizations as well as industry participants. Regular meetings of the working group are currently hosted by MTPC, DOER and the Forest and Wood Products Institutes at Mount Wachusett Community College.
- **Building Energy 2001.** MTPC co-sponsored a major conference organized by the New England Sustainable Energy Association. The two-day event held at Tufts University in March 2001 featured over 100 speakers who addressed issues ranging from the potential for developing offshore wind to the quality of building construction. During the conference, MTPC presented the

<sup>10</sup> See Strategic Direction Statement, Appendix D.

<sup>11</sup> There are many instances in which taxpayers currently benefit from employing particular accounting methodologies to secure tax benefits. Examples including the payment of health insurance premiums and expenses under IRC Section 125 and the treatment of long-term disability payments under IRC Section 104.

<sup>12</sup> The Private Letter Ruling is set forth in its entirety in Appendix C.

<sup>13</sup> Based on a highest Federal marginal tax rate of 39.6% and a flat State tax rate of 5.6%.





RET Northeast Green Building Awards to recognize exemplary projects that advance green building practices. MTPC has committed to be a major sponsor of Building Energy 2002.

- **Cape Wind Forums.** MTPC participated in a number of meetings and public forums throughout Cape Cod to discuss the merits and challenges of the 170-turbine, 420MW wind farm that developers are proposing to construct on Horseshoe Shoal in Nantucket Sound. In some instances, MTPC staff helped negotiate and design the format of the forums.
- **Community Forums.** In each of the last three years, MTPC and the Center for Ecological Technology have co-sponsored a series of community forums in the Berkshires on issues related to renewable energy.
- **Energy Security Meeting.** MTPC presented information on the role of renewable energy in a diversified energy portfolio at a breakfast roundtable entitled "Securing Energy in Insecure Times" in October 2001.
- **Green Building Symposia.** MTPC hosted two symposia in May 2001 that provided information about sustainable design, energy efficiency and renewable energy to local officials with responsibility for existing and proposed school facilities. Over 150 representatives of local school districts attended the events in Westborough and Northampton.
- **Legislative Briefings.** MTPC conducted and/or participated in numerous briefings on various aspects of the RET with members of the Legislature and their staffs.
- **Legislative Energy Summit.** Co-chaired by Representatives Bosley, Binienda, and Finneran, the meeting in October 2001 convened representatives from major stakeholder groups to assess the status of the Restructuring Act. It was the first in a series of such gatherings designed to determine whether the Restructuring Act is achieving desired goals and to determine any necessary adjustments.
- **National Association of Attorneys General (NAAG).** MTPC participated in the NAAG Eastern Region Meeting entitled, "Creating a Competitive Electricity Market for the Northeast: The Role of State Attorneys General".
- **NEPOOL Participants Committee.** MTPC has and will continue to participate in monthly NEPOOL meetings, particularly those that deal with the structure and operations of the wholesale market in the region. MTPC was active in discussions regarding the implementation of the Generation Information System (GIS). MTPC will continue to monitor the GIS as operational rules and standards are designed.
- **New England Wind Siting Workshop.** Held in October 2001, the conference addressed issues that currently pose barriers to wind development in New England. MTPC was a sponsor and presenter at this conference.
- **Power Breakfast.** MTPC co-sponsored a meeting for business leaders at Fidelity Investment's Marlborough facility in June 2001. The meeting addressed questions related to the energy crisis in California and its' implications for New England, and the critical need for uninterrupted power in an era dominated by electronics.
- **Renewable Portfolio Standard Public Hearings.** MTPC submitted comments on the proposed Renewable Portfolio Standard drafted by the Division of Energy Resources (DOER) and worked with the DOER to develop an alternative compliance mechanism.





- **Restructuring Roundtable Forums.** MTPC is a sponsor and a regular participant of the Restructuring Roundtable. The group meets monthly to discuss changes in the electric power industry in New England.



## **5 Charting the Future**

Despite the delay in commencing full operations pending resolution of the lawsuit challenging the constitutionality of the renewable energy charge, the organization has had significant accomplishments in a short period of time. MTPC now must build on the foundations established over the past 20 months, recognizing changes that are taking place in the renewable energy market.

This section of the report reviews the objectives and principles of the RET, and outlines the major elements of the overall strategy and programmatic initiatives. It should be noted that plans for particular programs will be refined and presented in the RET biennial operating plans. The FY2003-04 operating plan will be developed and presented to the MTPC Board of Directors for approval.

### **5.1 Goals, Objectives and Principles**

MTPC will continue to strive to accomplish the broad environmental and economic goals defined in the Electric Utility Restructuring Act. In keeping with these goals, MTPC has established four specific objectives:

- Shift electric energy consumption in Massachusetts away from conventional energy resources to a greater reliance on energy generated from renewable resources;
- Increase electric generating capacity from renewable resources to meet the growing energy demands of consumers in Massachusetts while also encouraging the adoption of energy efficiency measures;
- Expand and support the renewable energy sector in Massachusetts, including system developers, system integrators, manufacturers, equipment vendors, architects and engineers, service providers, and research organizations; and
- Increase the overall level of economic activity related to renewable energy in the Commonwealth.

Investments undertaken to advance the goals articulated in the Restructuring Act will continue to be informed and supported by certain underlying principles (as described in Section 3 of this Report).

### **5.2 Strategies and Programmatic Initiatives**

The basic strategy outlined in November 2000 is still sound and will continue to provide the overall direction for the RET over the next few years, taking changes in the market environment into account as warranted. The strategy contains five major elements:

- Promote the development of a sustainable market for green power in the Commonwealth;
- Promote greater use of renewable energy technologies in distributed generation in the Commonwealth;
- Support the growth of the renewable energy industry in Massachusetts;
- Accelerate research on advanced renewable energy technologies at Massachusetts universities; and
- Develop a baseline set of indicators on the characteristics of renewable energy generation, R&D, and related economic activity and track trends over time.

# THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth and change. From the first settlers to the present day, the nation has evolved through various stages of development. The early years were marked by exploration and settlement, followed by a period of rapid expansion and industrialization. The American Revolution was a pivotal moment in the nation's history, leading to the establishment of a new government and the declaration of independence. The Civil War was another major event, which resulted in the abolition of slavery and the preservation of the Union. The 20th century saw the United States emerge as a global superpower, with significant technological and cultural advancements. The Vietnam War and the Civil Rights Movement were also key events in this period. Today, the United States continues to face challenges and opportunities, and its history remains a source of inspiration and guidance for the future.

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A discussion of the four major elements of the strategy is described below along with the related programmatic initiatives that the organization intends to pursue.

### **5.2.1 Promote the development of a sustainable market for green power in the Commonwealth**

MTPC will continue to take steps to encourage demand for renewable energy among consumers who are willing to pay a premium for electricity generated from renewable resources and spur the development of *new* generating facilities that utilize cost-effective renewable energy technologies to meet this demand. This aspect of RET activities focuses on power fed into the regional power grid.

It is important to recognize that these efforts will take place in a market distinguished by the lack of competitive retail electricity suppliers and continued uncertainty with respect to the regulatory framework. In regard to the latter, regulations concerning the Renewable Portfolio Standard (RPS) are not expected to be finalized until later this year. The RPS has the potential to significantly alter the renewable energy market when it goes into effect in 2003. As currently detailed in the Final Proposed Regulations released by DOER on February 6, 2002, all retail electricity suppliers in Massachusetts (competitive electricity suppliers and electric distribution companies that provide standard offer and default services) initially will be required to obtain at least one percent of their electricity supplies from eligible renewable energy sources. The standard increases 0.5 percentage points each year through 2009 when it reaches four percent of total retail electricity sales in the Commonwealth. It is expected that additional renewable energy generating capacity will need to be built to satisfy the regulatory requirement.

The standard offer required under the Restructuring Act will expire in 2005. At that point, many observers anticipate that a competitive market driven by consumer choice based on price, service and energy source may begin to emerge in Massachusetts. If incentives for a competitive market start to take hold, new retail electricity suppliers would be expected to enter the market over time; some may offer green power products.

Over the next five years, MTPC plans to undertake the following activities to promote the development of sustainable green power markets:

- **Continue to support the establishment of consumer aggregations.** MTPC already has provided funding to nine consumer aggregations and intends to support the formation of additional groups through another solicitation scheduled for later this year. Over the next six to nine months, these groups will complete their initial market research and some will be in a position to enter into substantive negotiations with renewable energy generators or electricity suppliers to secure green power in keeping with members' stated requirements.<sup>14</sup> However, additional assistance may be needed to pool demand across aggregations to assemble sufficient demand (in terms of the magnitude and shape of load) to justify the establishment of necessary services for these consumer groups. MTPC will work with groups across the state to coordinate efforts, pool demand, and secure green power as required by members of the aggregations. This will include exploring the potential for securing power from proposed renewable energy generating projects in the region – some of which have received RET support for pre-development activities.

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<sup>14</sup> It is anticipated that the percentage of renewable energy in the energy mix purchased by the consumer aggregations will meet or exceed levels required for green-e certification.





- **Establish a new program to provide financing for renewable energy generation projects.** MTPC has provided funding to six projects for pre-development activities over the past year. While feasibility studies may suggest their technical and financial viability, some renewable energy projects may still find it difficult to secure financing from conventional sources, particularly in the absence of long-term power purchasing agreements. As a result, MTPC is actively considering how best to participate in financing large-scale wind, biomass, landfill gas and other types of renewable energy projects. The organization expects to provide financing for particular projects in the form of performance incentives, debt, near-equity or equity. Any loans provided by MTPC are likely to be subordinate to senior debt, giving MTPC second claim on any assets in the event of default. Given limited security and potential for financial gains, MTPC may require royalty participation, warrants convertible into equity, or title to some share of the resulting renewable energy certificates and/or energy. However, specific policies and procedures for project financing are still being defined. While the organization's due diligence in this area is ongoing, MTPC clearly recognizes that there will be risks associated with investments in nascent markets. Historically, investments in emerging companies and rapidly changing markets have been highly volatile. MTPC believes that there is an important, but limited role to play in providing financing for viable new sources of renewable energy that will feed power into the grid and enhance the renewable energy cluster in Massachusetts.
- **Participate in the development of a market for tradable renewable energy certificates.** The New England Power Pool (NEPOOL) and the New England ISO are in the process of developing a Generation Information System (GIS) to track generation attributes of energy generated in or imported into the NEPOOL control area. The system will enable electricity suppliers to demonstrate compliance with the RPS, emission regulations, and disclosure rules. Based on information maintained in the GIS, NEPOOL will issue certificates to energy generators that will allow parties to trade generation attributes separately and apart from any sales of the electricity generated by power plants. Electricity suppliers will need to demonstrate compliance with the RPS by holding certificates originally issued to eligible renewable generating facilities at the end of the year equal to the mandated level of megawatt hours. Electricity suppliers may obtain these certificates as part of power purchasing agreements or through transactions in secondary markets. Depending on the final regulations, MTPC is considering the role that it will play in the market for renewable energy certificates.

In this regard, it is important to note that DOER is considering establishing an alternative means for suppliers to comply with the RPS. Rather than purchase certificates, retail suppliers would be allowed to make a payment to MTPC at a rate of \$50/MWh (adjusted for inflation). MTPC would use the proceeds to purchase certificates from eligible generators through an auction with a maximum price equal to the payment received. MTPC would "retire" certificates that it purchases, meaning that certificates could not be transferred, sold or otherwise used for any other purpose.

### ***5.2.2 Promote greater use of renewable energy technologies in distributed generation***

MTPC will continue to undertake a broad range of activities to expand the use of fuel cells, PV systems and other eligible renewable energy technologies in distributed generation applications.



This aspect of RET activities focuses on generating facilities that are located on the customer-side of the meter or within *local* distribution networks.

Over the next five years, MTPC plans to undertake the following activities to promote the greater use of renewable energy technologies in distributed generation:

- **Continue to provide support for green schools and other green buildings.** As noted above, MTPC awarded \$1.3 million and encumbered an additional \$5 million in the first phase of the pilot Green Schools Program. A second round of competition in which another ten school districts will be selected is scheduled for November 2002. MTPC will conduct an extensive review of the results of the pilot program and, depending on the outcome, will consider the best way to expand green building practices in school districts throughout the Commonwealth. It is expected that the experience gained through these initial projects will be used by DOE to develop regulations and guidelines for all school districts that participate in the Commonwealth's School Building Assistance Program.

In addition to the Green Schools Program, MTPC is in the process of developing a new program to encourage green building practices in office buildings, affordable housing, industrial plants, retail facilities and other types of properties in Massachusetts. A draft of the program design has been developed and it is anticipated that it will be put before the Board of Directors in February 2002. It is expected that the program will include funding for initial feasibility studies (\$10,000 to \$20,000) and design and construction (\$550,000). Awards will be made on a competitive basis with separate competitions for two categories of organizations: (a) private companies and (b) public entities and tax-exempt organizations.

- **Continue to provide support for fuel cells in premium power applications.** MTPC has awarded planning grants to four organizations to examine the feasibility of using fuel cells to enhance the reliability of power for sensitive loads. MTPC will continue to solicit proposals for this purpose backed by an outreach campaign targeted toward three market niches: companies engaged in high volume transaction processing, companies operating 24x7 communications/information services, and public safety organizations. In regard to the latter, the organization has initiated discussions with public agencies in the Commonwealth to gauge their potential interest in the use of fuel cells to boost power reliability. It is expected that some of these organizations will return to MTPC for funding to help defray the cost of system installation.

There has been heightened awareness of energy security and reliability issues in the aftermath of the terrorist attacks on September 11<sup>th</sup>. MTPC intends to study the implications for the existing power infrastructure and the potential opportunities for distributed generation. Rationales and niche market opportunities for fuel cell-based premium power systems will be reevaluated. MTPC is particularly interested in the potential of fuel cells to address public health and safety concerns triggered by the threat of power supply disruptions. For example, fuel cells could be a viable option for community-based emergency centers and shelters.

MTPC will also explore the potential for working with electric distribution companies to improve the reliability of local distribution networks that are prone to power disruptions. It may be cost-effective to use fuel cells to supplement local distribution systems, reducing the need for costly upgrades.

Finally, it should be noted that MTPC has already provided funding for two fuel cell installations in Massachusetts. The Coast Guard is planning to install a molten carbonate fuel cell at the Coast

# THEORY OF THE EARTH

The theory of the earth is a branch of geology which deals with the origin and development of the earth and its various parts. It is a science which seeks to explain the processes which have shaped the earth and its features.

## THE EARTH'S HISTORY

The earth's history is a long and complex one, extending over billions of years. It is a history of change and development, of growth and decay, of life and death. The earth has been shaped by a variety of forces, both internal and external, and its features are the result of these forces acting over time.

The earth's history is divided into three main periods: the primary, the secondary, and the tertiary. Each of these periods is further divided into smaller units, and the events which have shaped the earth are recorded in the geological record.

The primary period is the earliest and longest of the three, extending from the beginning of time to the beginning of the secondary period. It is a period of great change and development, and it is in this period that the earth's basic features were first formed.

The secondary period is the middle period of the earth's history, extending from the beginning of the secondary period to the beginning of the tertiary period. It is a period of great change and development, and it is in this period that the earth's features were further shaped and modified.

The tertiary period is the latest and shortest of the three, extending from the beginning of the tertiary period to the present. It is a period of great change and development, and it is in this period that the earth's features were finally shaped and modified into the form we know today.

The earth's history is a long and complex one, and it is a history of change and development. It is a history which has shaped the earth and its features, and it is a history which we can still see and feel today.

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Guard Air Station on Cape Cod by early summer 2002; Nuvera has installed a proton membrane (PEM) fuel cell at a Verizon telecommunication switching facility. As noted above, award recipients are required to monitor the performance of the fuel cell systems after installation. This will enable MTPC to obtain and disseminate hard data on technical performance as well as the total cost of generating power using fuel cells.

- **Establish new programs to provide funding for PV system installations.** As noted above, MTPC has made a significant commitment to support greater use of photovoltaic (PV) systems in the Commonwealth. With the active involvement of SEBANE and other stakeholders, MTPC is finalizing plans for a series of programs that are geared specifically to the installations of PV systems in Massachusetts. Two programs will provide grants of up to \$4,000/kW to defray the cost of installing PV systems in existing and new buildings, representing a total outlay of approximately \$4.1 million over three years. As part of this effort, MTPC will monitor the performance of installed PV systems to ensure that systems are maintained adequately and obtain hard data on system reliability and energy output. (A third program will grant \$300,000 to support the establishment of a training and certification program for installers of PV systems.)

### ***5.2.3 Support the growth of the renewable energy industry in Massachusetts***

MTPC will continue to support and seek to enhance the cluster of Massachusetts renewable energy-related companies. Members of this industry cluster range from manufacturers of materials, components and systems to a wide variety of service firms, including architects, engineers, distributors, and system installers. In fact, while members of the renewable energy cluster share certain common interests, objectives, and characteristics, the cluster also encompasses a set of sub-clusters with unique concerns that are identified by different technology or market focus.

MTPC has engaged in successful cluster-based activities through its Massachusetts Technology Collaborative operation in a wide range of areas - - from the formation of a medical device industry trade group, to a regional collaboration of businesses, municipalities, citizens and environmentalists situated along the I-495 corridor, to a series of initiatives designed to bolster access to high-speed telecommunications infrastructure in underserved areas of the Commonwealth (for additional information on the organization's Cluster Initiative please consult the website, [www.mtpc.org](http://www.mtpc.org)). MTPC intends to exploit this wealth of experience and apply lessons learned and applicable elements of the cluster methodology and "toolbox."

Many of the activities undertaken as part of the strategies to promote a sustainable market for green power and greater use of renewable energy technologies in distributed generation will have a positive impact on renewable energy companies in Massachusetts. However, in keeping with the legislation, MTPC will also provide direct assistance to these firms to encourage their continued presence and expansion in the Commonwealth.

Over the next five years, MTPC plans to undertake the following activities to support the growth of the renewable energy cluster in Massachusetts:

- **Continue to build renewable energy industry associations.** Collaborative efforts among businesses and institutions in the Commonwealth can help to identify problems and opportunities within industries and to develop an appropriate course of action. MTPC plans to continue to support SEBANE; however, the magnitude and nature of this support is likely to evolve over time as the association matures.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and the role of the accounting department in ensuring the integrity of the financial data.

2. It then outlines the various methods used to collect and analyze financial information, including the use of spreadsheets and specialized software.

3. The document also addresses the challenges faced by the accounting department in dealing with complex financial data and the need for ongoing training and development.

4. Finally, it provides a summary of the key findings and recommendations for improving the efficiency and effectiveness of the accounting process.

In addition, MTPC will explore the possibility of establishing an industry association for companies involved in the fuel cell industry. Potential participants include manufacturers of fuel stacks, plates, electrolytes, catalyst material, reformers, power electronics, inverters, air handling equipment, and storage tanks as well as distributors, system installers and maintenance companies. Initial activities will center on a series of sponsored events focusing on federal funding opportunities and other issues of importance to the industry.

- **Establish a new program to provide business assistance services to renewable energy companies.** A number of companies in the renewable energy sector are small, research-based firms with limited expertise in planning, marketing, production, and other functional areas that are critical to long-term success. Many of these companies face difficulties in accessing needed business services. To help address this problem, MTPC plans to establish a new program in conjunction with the Massachusetts Strategic Envirotechnology Partnership (STEP) – a joint venture of the University of Massachusetts and the Executive Office of Environmental Affairs. While the agreement is still being finalized, initial plans call for STEP to work with renewable energy companies in Massachusetts, providing assistance in identifying promising market opportunities, developing business strategies, improving operations, and brokering strategic partnerships with other firms and institutions.
- **Establish a new program to provide financing for renewable energy companies.** A significant percentage of renewable energy companies are quite small and lack needed capital for expansion. As part of the Solar-to-Market Initiative, MTPC is considering a \$5.3 million loan fund specifically for PV-related companies located or doing business in Massachusetts. The organization is also investigating the establishment of an equity-based investment fund targeted toward early stage renewable energy companies. If pursued, MTPC would issue a solicitation to select an investment fund manager on a competitive basis in line with the legislation.

#### ***5.2.4 Accelerate research on advanced renewable energy technologies at Massachusetts universities***

Private and public universities in Massachusetts have long played a central role in advancing fundamental knowledge and producing a highly skilled workforce. Increasingly, over the past two decade, universities have also assumed a more prominent role in commercially-oriented research and adopted a much more aggressive stance with respect to moving technology from the laboratory to the marketplace. This includes efforts related to the development and commercialization of advanced renewable energy technologies.

MTPC plans to take steps to ensure that the state is positioned to capitalize on the significant capabilities within universities across the Commonwealth. In this regard, within the next five years, the organization expects to accelerate research on advanced renewable energy technologies through the following activity:

- **Establish a new program to provide funding for cooperative R&D efforts involving renewable energy companies and universities.** MTPC plans to provide funding for research and development activities at universities in Massachusetts, focusing on resolving barriers to the widespread commercialization of renewable energy technologies in both central and distributed power generation. It is anticipated that the cooperative R&D program will require universities to undertake research in conjunction with companies to help ensure that the research agenda focuses on issues of paramount concern to industry.

1. The first part of the document is a letter from the President of the United States to the Congress, dated January 3, 1862. It is a very important document, as it contains the President's views on the state of the Union and the progress of the war.

2. The second part of the document is a report from the Secretary of the War Department, dated January 10, 1862. It contains a detailed account of the military operations of the Army during the year 1861.

3. The third part of the document is a report from the Secretary of the Navy Department, dated January 15, 1862. It contains a detailed account of the naval operations of the Navy during the year 1861.

4. The fourth part of the document is a report from the Secretary of the Department of the Interior, dated January 20, 1862. It contains a detailed account of the operations of the Department during the year 1861.

5. The fifth part of the document is a report from the Secretary of the Department of the Treasury, dated January 25, 1862. It contains a detailed account of the operations of the Department during the year 1861.

6. The sixth part of the document is a report from the Secretary of the Department of the State, dated February 1, 1862. It contains a detailed account of the operations of the Department during the year 1861.

7. The seventh part of the document is a report from the Secretary of the Department of the War, dated February 5, 1862. It contains a detailed account of the operations of the Department during the year 1861.

8. The eighth part of the document is a report from the Secretary of the Department of the Navy, dated February 10, 1862. It contains a detailed account of the operations of the Department during the year 1861.

9. The ninth part of the document is a report from the Secretary of the Department of the Interior, dated February 15, 1862. It contains a detailed account of the operations of the Department during the year 1861.

10. The tenth part of the document is a report from the Secretary of the Department of the Treasury, dated February 20, 1862. It contains a detailed account of the operations of the Department during the year 1861.



### **5.2.5 Develop a baseline set of indicators on the characteristics of renewable energy generation and consumption, R&D, and related economic activity and track trends over time**

MTPC began the process of identifying and analyzing renewable energy technologies, markets, companies, and green power generation to create an in-depth fact base that would inform the planning process that led to the release of the initial *Detailed Plan* in November 2000. An early component of this effort was the study, “*Profiles of Leading Renewable Energy Technologies*” published in October 1998 by MTPC in collaboration with Arthur D. Little, Inc. MTPC continues to publish and support studies on a wide range of renewable energy issues, as detailed in Section 4.3.2 of this Report. MTPC recognizes the need to supplement intensive, issue-specific studies by establishing a comprehensive benchmarking effort to serve as a centralized source of renewable energy data and trends. Once established, data can be monitored over time to identify trends and analyze the implications for the Commonwealth’s policy makers, business leaders, environmental advocates, and concerned citizens. This type of benchmarking effort is particularly critical given the dynamic and evolving nature of many renewable energy markets and the nascent status of the green power market.

- **Publish an annual “Index” of renewable energy indicators.** MTPC has published its “Index of the Massachusetts Innovation Economy” since 1997, which contains over 30 indicators tracking the performance of key industry clusters, its outputs, and the infrastructure that supports it. The Commonwealth’s performance is measured against other leading technology states. In a similar vein, MTPC intends to produce a “Renewable Energy Index” that would collect objective and reliable data that is statistically measurable on an ongoing basis. MTPC is considering indicators drawn from at least three areas of interest: (1) Generation and Consumption of Renewable Energy – data and analysis on the number, types and quantity of electricity generated from renewable sources in Massachusetts and purchased by Massachusetts consumers; (2) Renewable Energy Industry Cluster – data and analysis that characterizes and quantifies Massachusetts-based renewable energy firms and related suppliers and services; (3) Research and Development – data and analysis that characterizes the renewable energy-related research and development undertaken in Massachusetts, including the focus of this research activity and the performers of this research. Massachusetts’ performance in these areas could be measured against other relevant states.

## **5.3 Waste-to-Energy Program**

As noted above, awards have been approved to some 138 communities under this program. Most disbursements will be made within the next two years; however, in some cases, MTPC has permitted communities to draw down on monies as their contractual obligations arise. Some communities will be reimbursed for eligible expenses over the remaining terms of existing contracts, which in some cases extend out to 2016.

RET staff will continue to monitor eligible expenses and administer the grant program over the next five years and beyond.



# THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth and change. From the first settlers to the present day, the nation has evolved through various stages of development. The early years were marked by exploration and settlement, followed by a period of rapid expansion and industrialization. The American Revolution and the Civil War were pivotal moments in the nation's history, shaping its identity and values. The 20th century brought significant social and political changes, including the rise of the New Deal and the Civil Rights Movement. Today, the United States continues to face new challenges and opportunities, reflecting its ongoing journey as a nation.

The early years of the United States were characterized by a spirit of adventure and exploration. Settlers from Europe and other parts of the world came to the New World in search of new opportunities and a better life. The land was vast and uncharted, offering endless possibilities for growth and discovery. As the population grew, so did the need for organized governance and infrastructure. The early years were a time of great challenges and triumphs, as the nation built its foundations and established its identity. The American Revolution was a defining moment, as the colonies fought for independence from British rule. The Civil War was another pivotal event, as the nation grappled with the issue of slavery and the preservation of the Union. These events shaped the course of American history and influenced the nation's future.

The 20th century was a period of rapid change and progress. The United States emerged as a global superpower, leading the world in science, technology, and culture. The New Deal era brought significant social and economic reforms, addressing the challenges of the Great Depression. The Civil Rights Movement fought for equality and justice for all Americans, leaving a lasting legacy. The space race and the Vietnam War were major events that defined the era. Today, the United States continues to play a leading role in the world, facing new challenges and opportunities. The history of the United States is a testament to the power of the American dream and the resilience of the nation.

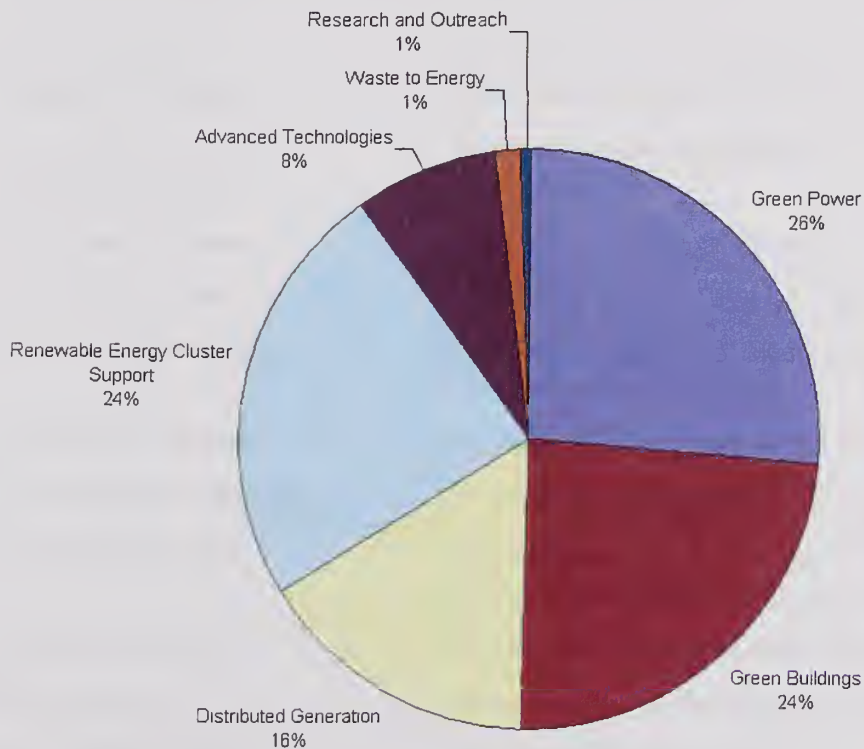
## 5.4 Preliminary Five-Year Projections

The renewable energy charge is projected to generate roughly \$127 million over the next five years, depending on the rate of growth of electricity consumption in the Commonwealth. Interest and investment income is expected to be almost \$19 million, bringing total currently-estimated revenues in the five-year period to approximately \$146 million.

MTPC expects that, during this five-year period, annual expenditures for funded initiatives and program expenses will significantly outpace new receipts. As a result, the organization will draw down current RET balances over the next five years.

Figure 1 summarizes the preliminary projected allocation of RET funds among major programmatic initiatives over the five-year period. These are MTC's best current estimates, and the allocations can be expected to change over time as we update our plans and budgets on a regular basis over the five-year period.

**Figure 1. Preliminary Projected Program Allocation (1/1/02-12/31/06)**





## 6 Governance, Management, Operations and Financial Information

### 6.1 Board of Directors and RET Advisory Committees

The MTPC Board of Directors has statutory authority for the RET and oversees its operations. The Board of Directors serves without compensation and consists of senior managers from industry, academia, and government as shown in Table 2.

**Table 2. MTPC Board of Directors**

<b>Dr. Karl Weiss</b> <i>Board Chairperson</i>	Professor Emeritus Northeastern University
<b>Mr. David D. Fleming</b> <i>Board Vice-Chairperson</i>	Group Senior Vice President Genzyme Corporation
<b>The Honorable Elizabeth F. Ames</b> <i>Executive Committee</i>	Economic Development Chief and Senior Policy Adviser for Economic Affairs and Technology, Department of Economic Development
<b>Dr. Paul C. Martin</b> <i>Executive Committee</i>	John H. Van Vleck Professor of Pure and Applied Physics, Dean for Research and Information Technology, Harvard University
<b>Mr. Lawrence J. Reilly</b> <i>Executive Committee</i>	Senior Vice President, General Counsel and Secretary, National Grid USA
<b>Mr. William M. Bulger</b>	President, University of Massachusetts
<b>Mr. Richard C. Caparso</b>	President, Vanguard Group of Companies
<b>Dr. Aram V. Chobanian</b>	Provost, Medical School Campus, Boston University Dean, School of Medicine, Boston University
<b>Mr. Michael J. Cronin</b>	President & CEO, Cognition Corporation
<b>Mr. Thomas A. Farrington</b>	President & CEO, Farrington Associates, Inc.
<b>Dr. Patricia M. Flynn</b>	Dean, Graduate, Executive and Professional Education, McCallum Graduate School of Business, Professor of Economics, Bentley College
<b>Ms. Debra Germaine</b>	Director/Partner, Heidrick & Struggles/Fenwick Partners
<b>Ms. Judith I. Gill</b>	Chancellor, Massachusetts Board of Higher Education
<b>Mr. C. Jeffrey Grogan</b>	Vice President, Monitor Group, LP
<b>Mr. Alain J. Hanover</b>	Managing Director & CEO, Navigator Technology Ventures
<b>Ms. Gloria C. Larson</b>	Partner, Foley, Hoag & Eliot LLP
<b>Dr. Aaron Lazare</b>	Chancellor, University of Massachusetts Medical School
<b>Mr. John T. Preston</b>	President & CEO, Atomic Ordered Materials, LLC Senior Lecturer, Massachusetts Institute of Technology
<b>The Honorable Kevin Sullivan</b>	Secretary of the Executive Office for Administration and Finance





<b>Dr. Adrian Tinsley</b>	President, Bridgewater State College
<b>Dr. Sidney Topol</b>	President, The Topol Group, LLC
<b>Dr. Laurence G. Walker</b>	CEO & President, C-Port Corporation

Under the Electric Utility Industry Restructuring Act of 1997, the Governor appointed an Advisory Committee to provide policy advice to the MTPC Board of Directors with respect to the RET. Current members of the RET Advisory Committee are listed in Table 3. The Committee played an instrumental role in reviewing the original strategic and operating plan, and will be asked to provide input at other critical junctures in the evolution of the RET.

**Table 3. RET Advisory Committee**

<b>Christopher R. Anderson, Esq.</b>	President, Massachusetts High Technology Council
<b>Mr. Vahan Basmajian</b>	Chairman of the Board, President, Megatech Corporation
<b>The Honorable Jennifer Davis Carey</b>	Director, Mass. Dept. of Consumer Affairs and Business Regulation
<b>The Honorable Robert Durand</b>	Secretary, Massachusetts Executive Office of Environmental Affairs
<b>Richard Kennelly, Esq.</b>	Staff Attorney, Conservation Law Foundation
<b>Ms. Kathleen Loftus</b>	Energy & Regulatory Affairs Manager, Shaw's Supermarkets/Star Markets, Inc.
<b>Mr. Alan Noguee</b>	Senior Energy Analyst, Union of Concerned Scientists
<b>Mr. Wayne Pacheco</b>	Controller of Worldwide Facilities, EMC Corporation
<b>Dr. Jefferson Tester</b>	H.P. Meissner Professor of Chemical Engineering and Energy Laboratory, MIT Energy Laboratory

## **6.2 Management, Staffing and Operations**

MTPC has established an operating division with responsibility for the RET. The division includes a small professional and administrative staff with suitable background and skills. The division also draws on consultants and other organizations to undertake specific activities on a contract basis, supplementing internal capabilities without incurring the costs of building and maintaining a large, permanent staff. Core administrative functions including information systems management, financial administration, and legal counsel are provided by MTPC as part of its ongoing corporate responsibilities.

Finally, it is important to note that MTPC has established a number of review panels to support various RET initiatives. In particular, MTPC has convened experts in requisite fields to undertake independent, systematic reviews of major funding proposals submitted by other organizations under different initiatives. Panel members have provided an objective assessment of the merits of individual proposals and helped to identify areas warranting further elaboration and/or modification.



Final approval for funding decisions, however, rests solely with the MTPC Board of Directors. Members of the expert panels are identified in Table 4.

**Table 4. RET Review Panels and Working Groups**

**GREEN BUILDINGS**

<b>Paul Nakazawa</b> <i>Chairperson</i>	President, Nakazawa Consultants
<b>Rick Mattila</b>	Genzyme Corporation (certified LEED evaluator)
<b>Janet Gail Besser</b>	Lexecon Incorporated
<b>Barbra Batshalom</b>	Green Round Table
<b>Joy Conway</b>	Greater Boston Real Estate Board
<b>David Weitz</b>	Mass Board of Building Regulations and Standards
<b>Chris Schaffner</b>	Ove Arup Partnership Ltd.
<b>John DiModica</b>	Massachusetts Division Capital Asset Management

**FUEL CELLS AND DISTRIBUTED GENERATION**

<b>Dr. Gerald L. Wilson</b> <i>Chairperson</i>	Professor of Electrical & Mechanical Engineering Massachusetts Institute of Technology
<b>Dr. Jon G. McGowan</b>	Professor of Mechanical Engineering, University of Massachusetts
<b>Mr. Stephen A. Fairfax</b>	President, MTechnology, Inc.
<b>Dr. John J. Bzura</b>	Principal Engineer, National Grid USA Service Company
<b>Mr. Wayne Pacheco</b>	Controller of Worldwide Facilities, EMC Corporation
<b>Mr. Michael J. Cronin</b>	President and CEO, Cognition Corporation
<b>Mr. Christopher R. Anderson</b>	President, Massachusetts High Technology Council
<b>Mr. Bill Brissette</b>	Facilities Manager, Kopin Corporation

**PHOTOVOLTAIC WORKING GROUP**

<b>Mr. Claudio Borea</b>	Northeast Utilities Services Co.
<b>Mr. Roger Borghesani</b>	The Energy Consortium
<b>Mr. Warren Boutin</b>	NSTAR
<b>Dr. John J. Bzura</b>	National Grid USA Service Company
<b>Ms. Marybeth Campbell</b>	Committee on Energy, State House
<b>Ms. Anne Canaday</b>	Executive Office of Environmental Affairs
<b>Mr. Larry Chretien</b>	Mass Energy Consumers Alliance
<b>Mr. Stephen R. Connors</b>	Massachusetts Institute of Technology
<b>Mr. Ross Donald</b>	Renewable News Network
<b>Mr. Gene Fry</b>	Department of Telecommunications and Energy



<b>Mr. Gagne Thomas</b>	Northeast Utilities
<b>Mr. Roger Gibson</b>	Northeast Utilities System
<b>Mr. Paul Gromer</b>	Peregrine Energy Group, Inc.
<b>Ms. Sonia Hamel</b>	Executive Office of Environmental Affairs
<b>Ms. Andrea Hattan</b>	Division of Energy Resources
<b>Mr. Elliott Jacobson</b>	Low-Income Energy Affordability Network
<b>Mr. Richard Kennelly</b>	Conservation Law Foundation
<b>Ms. Judy Laster</b>	Office of the Attorney General
<b>Mr. Warren Leon</b>	Northeast Sustainable Energy Association
<b>Ms. Kathleen Loftus</b>	Shaw's Supermarkets/Star Markets, Inc.
<b>Mr. John Manning</b>	Peregrine Energy Group, Inc.
<b>Dr. James F. Manwell</b>	Renewable Energy Research Lab
<b>Ms. Lisa Yarid Marsh</b>	Committee on Energy, State House
<b>Mr. Richard Michaud</b>	U.S. Department of Energy
<b>Mr. Lewis Milford</b>	Clean Energy Group
<b>Mr. John Moskal</b>	U.S. Environmental Protection Agency -Region I
<b>Ms. Nancy Nylen</b>	Center for Ecological Technology
<b>Ms. Angela O'Connor</b>	Associated Industries of Massachusetts
<b>Mr. John Simmons</b>	Massachusetts Health & Education Facilities Authority
<b>Mr. David Tannozi</b>	City of Newton
<b>Ms. Kate Warner</b>	Cape Light Compact
<b>Ms. Jane Weissman</b>	Photovoltaics for You
<b>Mr. Norman Willard</b>	U.S. Environmental Protection Agency -Region I
<b>Mr. Peter Wingate</b>	Worcester Community Action

### **6.3 Financial Report**

As shown in Table 1, proceeds from the renewable energy charge totaled \$168.8 million as of December 31, 2001. In addition, the RET has earned approximately \$13.2 million in interest on monies held in the RET account.<sup>15</sup>

As of December 31, 2001, the MTPC Board of Directors had approved grants and loans of approximately \$58.9 million. Of this amount, \$22.8 million has been disbursed; the remaining \$36.1 million in outstanding awards will be disbursed according to the award contracts pending satisfactory

<sup>15</sup> The MTPC Board of Directors has established an Investment Committee to make recommendations to the Board concerning the investment of RET assets pending their use. To date, the RET assets have been invested in the Massachusetts Municipal Depository Trust (MMDT), an investment pool for the Commonwealth and its political subdivisions designed to invest available cash. The primary purpose of the MMDT is to offer participation in a diversified portfolio of high quality money market instruments that seeks to obtain the highest possible level of current income consistent with the preservation of capital and liquidity. The Investment Committee has hired an investment adviser, New England Pension Consultants, to help formulate an investment policy prescribing a more diversified portfolio of investment instruments that could provide a higher long-term return than can be obtained via money market instruments alone, consistent with the preservation of capital.





performance of the recipient. (Details of grants and loans awarded under RET programs are provided in Appendix B.) In addition, MTPC expended roughly \$537,000 on sponsored studies, seminars, conferences and other information services.

Program personnel and direct expenses totaled approximately \$4.5 million through December 31, 2001. Allocated management and administrative expenses amounted to roughly \$3.9 million over this same time period. MTPC has invested roughly \$3.4 million in start-up cost for program development and approximately \$688,000 in capital expenditures, including initial planning efforts and the establishment of necessary financial and administrative systems.

**Table 1. RET Revenues and Expenditures through December 31, 2001**

	March 1, 1998 to December 31, 2001
<b>Revenues</b>	
Proceeds from renewable energy charge	168,841,370
Interest and investment income	<u>13,197,722</u>
<b>Total revenues</b>	<b>182,039,092</b>
<b>Expenditures</b>	
<b>Funded Initiatives</b>	
Grants, loans and investments <sup>(a)</sup>	58,933,856
Sponsored studies, seminars and conferences	<u>536,886</u>
<b>Total Funded Initiatives</b>	<b>59,470,742</b>
<b>Operating expenses</b>	
Program personnel and direct expenses <sup>(b)</sup>	4,546,651
General management and administration <sup>(c)</sup>	<u>3,926,228</u>
<b>Sub-total operating expenses</b>	<b>8,472,879</b>
Start-up costs for program development <sup>(d)</sup>	3,447,123
Capital expenditures	<u>688,622</u>
<b>Total expenditures</b>	<b>72,079,366</b>
<b>Uncommitted Funds <sup>(e)</sup></b>	<b>109,959,726</b>

**Notes:**

(a) This represents the dollar value of grants, loans and investments at the time of approval by the MTPC Board of Directors and notification of award to the recipient. As of December 31, 2001, the MTPC Board of Directors had approved a total of \$53.7 million in grants to communities under the waste-to-energy program and \$5.2 million in grants and loans to various recipients under the renewable energy program. Of the total grants and loans awarded, \$22.8 million has been disbursed; the remaining \$36.1 million in outstanding awards will be disbursed according to the award contracts pending satisfactory performance of the recipient.

(b) Program personnel and direct expenses includes salaries and benefits for MTPC staff dedicated fully to RET as well as expenses directly related to RET programs. This category also includes the cost of technical assistance to grant applicants and the evaluation of ongoing projects.

(c) General management and administration includes costs incurred by the corporation that are allocated to the RET. This includes an allocable portion of the corporation's personnel and other costs associated with such functions as general management, information systems, finance and accounting, human resources, facilities, legal, and general administration. Expenses are allocated based on labor.

(d) Start-up costs for program development consist primarily of professional services employed in planning and launching the RET programs, and includes the costs of resolving the lawsuit challenging the constitutionality of the mandatory charges for energy efficiency and renewable energy programs.

(e) Uncommitted funds represent monies available at the end of the period for funded initiatives and expenditures after adjustment for remaining disbursements of outstanding awards.



## Appendix A . RET Enabling Legislation





**1997 Legislation. St. 1997, c. 164, § 37, an emergency act, approved November 25, 1997, replaced section 18 of chapter 25 with three new sections, including a new section 20 which provided:**

“Section 20. (a)(1) Beginning on March 1, 1998, the department is hereby authorized and directed to require a mandatory charge per kilowatt-hour for all electricity ratepayers of the commonwealth, except those ratepayers served by a municipal lighting plant which does not supply generation service outside its own service territory or does not open its service territory to competition at the retail level, to support the development and promotion of renewable energy projects in accordance with the provisions of section 4E of chapter 40J. Said charge shall be the following amounts: three-quarters of one mill (\$0.00075) per kilowatt-hour in calendar year 1998; one mill (\$0.001) per kilowatt-hour in calendar year 1999; one and one-quarter mill (\$0.00125) per kilowatt-hour in calendar year 2000; one mill (\$0.001) per kilowatt-hour in calendar year 2001; three-quarters of one mill (\$0.00075) per kilowatt-hour in calendar year 2002; and one-half of one mill (\$0.0005) per kilowatt-hour in each calendar thereafter.

“(2) In calendar year 1998 through calendar year 2002, the revenues derived from one-quarter of one mill (\$0.00025) of the charge assessed pursuant to the preceding paragraph in each such year shall be set aside and expended pursuant to implementing the provisions of paragraph (2) of subsection (i) of section 4E of chapter 40J.

“(b) In the fiscal year ending on June 30, 2001, the board of directors of the Massachusetts Technology Park Corporation shall, in consultation with the advisory committee established pursuant to subsection (h) of section 4E of chapter 40J, the department of telecommunications and energy, and the division of energy resources, review the adequacy of the monies generated by said mandatory charge in meeting the requirements of said section 4E of said chapter 40J. If, after such review, said board determines that an adjustment in said mandatory charge is necessary, said board shall file recommendations in the form of legislation with the clerk of the house of representatives. On or before January 1, 2002, said board shall submit to the house and senate committees on ways and means and the joint committee on government regulations a report which reviews in detail the activities and expenditure of the Massachusetts Renewable Energy Trust Fund to date and proposed activities and funding levels of said trust fund for the succeeding five years for review and approval thereby; provided, however, that said proposed activities continue to achieve the objectives of the program. Following receipt of the five-year report from said board, the house and senate committees on ways and means and the joint committee on government regulations shall meet jointly and with sufficient public notice for the purposes of conducting a public hearing to review the contents of said report; provided, however, that the five-year review shall be made available to the public no later than 45 days before said public hearing.

“(c) The revenues generated by said mandatory charge shall be remitted to the Massachusetts Technology Park Corporation and deposited into the Massachusetts Renewable Energy Trust Fund, established pursuant to section 4E of chapter 40J. The public purpose of said trust fund shall be to generate the maximum economic and environmental benefits over time from renewable energy to the ratepayers of the commonwealth through a series of initiatives which exploits the advantages of renewable energy in a more competitive energy marketplace by promoting the increased availability, use, and affordability of renewable energy and by fostering the formation, growth, expansion, and retention within the commonwealth of preeminent clusters of renewable



energy and related enterprises, institutions, and projects, which serve the citizens of the commonwealth.”

The following Section 4E was added by Section 68 of Chapter 164 of the Acts of 1997, effective November 25, 1997]

#### **§ 4E. Massachusetts Renewable Energy Trust Fund**

(a) There is hereby established and set up on the books of the corporation a separate trust fund to be known as the Massachusetts Renewable Energy Trust Fund, hereinafter referred to as the fund. The corporation shall hold the fund in an account or accounts separate from other funds in those provisions of the second and third paragraphs of section 5 as apply to the center fund in the corporation, and shall apply as well to the fund. There shall be credited to the fund all amounts collected pursuant to section 20 of chapter 25 and any income derived from the investment of amounts credited to the fund. All amounts credited to the fund shall be held in trust and used solely for activities and expenditures consistent with the public purpose of the fund as set forth in subsection (b) of this section; provided, however, that monies derived pursuant to paragraph (2) of subsection (a) of section 20 of chapter 25 shall be especially segregated for implementing the purposes of paragraph (2) of subsection (f) of this section.

(b) The board may draw upon monies in the fund for the public purpose of generating the maximum economic and environmental benefits over time from renewable energy to the ratepayers of the commonwealth through a series of initiatives which exploits the advantages of renewable energy in a more competitive energy marketplace by promoting the increased availability, use, and affordability of renewable energy, by making operational improvements to existing renewable energy projects and facilities which, in the determination of the board, have achieved results which would indicate that future investment in said facilities would yield results in the development of renewable energy more significant if said funds were made available for the creation of new renewable energy facilities, and by fostering the formation, growth, expansion, and retention within the commonwealth of preeminent clusters of renewable energy and related enterprises, institutions, and projects, which serve the citizens of the commonwealth.

(c) Public interests to be advanced through the board's actions shall include, but not be limited to, the following: (i) the development and increased use and affordability of renewable energy resources in the commonwealth and the New England region; (ii) the protection of the environment and the health of the citizens of the commonwealth through the prevention, mitigation, and alleviation of the adverse pollution effects associated with certain electricity generation facilities; (iii) the delivery to all ratepayers of the commonwealth of as many benefits as possible created as a result of increased fuel and supply diversity; (iv) the creation of additional employment opportunities in the commonwealth through the development of renewable technologies; (v) the stimulation of increased public and private sector investment in, and competitive advantage for, renewable energy and related enterprises, institutions, and projects in the commonwealth and the New England region; and (vi) the stimulation of entrepreneurial activities in these and related enterprises, institutions, and projects.

(d) In furtherance of these and other public purposes and interests, the board may expend monies from the fund to make grants, contracts, loans, equity investments, energy production credits, bill credits, or rebates to customers, to provide financial or debt service obligation assistance, or to take any other actions, in such forms, under such terms and conditions and pursuant to such selection procedures as the board deems appropriate and otherwise in a manner consistent with





good business practices; provided, however, that the board shall generally employ a preference for competitive procurements; provided, further, that the board shall endeavor to leverage the full range of the resources, expertise, and participation of other state and federal agencies and instrumentalities in the design and implementation of programs under this section; and provided, further, that the board has determined and incorporated into the minutes of its proceedings a finding that such actions are calculated to advance the public purpose and public interests set forth in this section, including, but not limited to, the following: (i) the growth of the renewable energy-provider industry; (ii) the use of renewable energy by electricity customers in the commonwealth; (iii) public education and training regarding renewable energy; (iv) product and market development; (v) pilot and demonstration projects and other activities designed to increase the use and affordability of renewable energy resources by and for ratepayers in the commonwealth; (vi) the provision of financing in support of the development and application of related technologies at all levels, including, but not limited to, basic and applied research and commercialization activities; (vii) the design and making of improvements to existing renewable energy projects and facilities as defined herein which were in operation as of December 31, 1997; and (viii) matters related to the conservation of scarce energy resources.

The board shall, in consultation with the division of energy resources and the advisory committee established pursuant to subsection (i), adopt a detailed plan for the application of the fund in support of the design, implementation, evaluation, and assessment of a renewable energy program for the commonwealth, subject to periodic revision by the board, that ensures that the fund shall be employed to provide financial and non-financial resources to overcome barriers facing renewable energy enterprises, institutions, and projects in a prudent manner consistent with the public purposes and interests set forth in this section. Said plan, to the extent practicable, shall consist of at least four components: (i) "product and market development" to establish a foundation for growth and expansion of the commonwealth's renewable energy enterprises, institutions, and projects, including pilot and demonstration projects, production incentives, and other activities designed to increase the use and affordability of renewable energy in the commonwealth; (ii) "training and public information" to allow for the development and dissemination of complete, objective, and timely information, analysis, and policy recommendations related to the advancement of the public purposes and interests of the renewable energy fund; (iii) "investment" to support the growth and expansion of renewable energy enterprises, institutions, and projects; and (iv) "research and development" within the commonwealth and the New England region related to renewable energy matters. Said plan shall specify the expenditure of such monies from the fund to each of these component activities; provided, however, that monies so expended shall be used to develop such renewable energy projects with priority given to projects, institutions, and enterprises, first, within the commonwealth; next, to such activities within New York and the New England region which serve the regional power grid; and finally, all other such activities regardless of location. In developing said plan, the board is hereby authorized and directed to consult with and utilize the services of the department of telecommunications and energy and the division of energy resources for such technical assistance as the board deems necessary or appropriate to the effective discharge of the board's responsibilities and duties relative to the fund.

(e) Subject to the approval of the board, investment activity of monies from the fund may consist of the following: (i) an equity fund, to provide risk capital to renewable energy enterprises, institutions, and projects; (ii) a debt fund, to provide loans to energy enterprises, institutions, projects, intermediaries, and end-users; and (iii) a market growth assistance fund, to be used to attract private capital to the equity and debt funds. To implement these investment activities, the corporation is





hereby authorized to retain, through a bid process, a public or private sector investment fund manager or managers, who shall have prior knowledge and experience in fund management and possess related skills in renewable energy and related technologies development, to direct the investment activity described herein and to seek other fund co-sponsors to contribute public and private capital from the commonwealth and other states; provided, however, that such capital is appropriately segregated. Said manager or managers, subject to the approval of the board, shall be authorized to retain necessary services and consultants to carry out the purposes of the fund. Said manager or managers shall develop a business plan to guide investment decisions, which shall be approved by the board prior to any expenditures from the trust fund and which shall be consistent with the provisions of the plan for the fund as adopted by the board.

(f) (1) For the purposes of expenditures from the fund, renewable energy technologies eligible for assistance shall include the following: solar photovoltaic and solar thermal electric energy; wind energy; ocean thermal, wave, or tidal energy; fuel cells; landfill gas; waste-to-energy which is a component of conventional municipal solid waste plant technology in commercial use; naturally flowing water and hydroelectric; low emission, advanced biomass power conversion technologies, such as gasification using such biomass fuels as wood, agricultural, or food wastes, energy crops, biogas, biodiesel, or organic refuse-derived fuel; and storage and conversion technologies connected to qualifying generation projects; provided, however, that expenditures related to waste-to-energy projects or facilities shall be limited to funds segregated pursuant to paragraph (2). Such funds may also be used for appropriate joint energy efficiency and renewable projects, as well as for investment by distribution companies in renewables and distributed generation opportunities, if consistent with the provisions of this section. The following technologies or fuels shall not be considered renewable energy supplies: coal, oil, natural gas except when used in fuel cells, and nuclear power.

(2) The board shall make available from monies in the fund in accordance with subsection (a) grants to municipalities and other governmental bodies to provide debt service assistance in conjunction with alleviating payment obligations incurred by said municipalities and other governmental bodies through an existing contractual agreement pursuant to the installation of pollution control technology and the implementation of other operational improvements to existing renewable energy projects and facilities in the commonwealth utilizing waste-to-energy technology as a component of municipal solid waste plant technology in commercial use, or the closure of any such existing facilities; provided, however, that such grants shall not exceed, in the aggregate, in any calendar year prior to calendar year 2003 the amount segregated in the fund pursuant to this paragraph in the calendar year previous thereto; provided further, that no such grants shall be made from any funds collected for the fund in any calendar year subsequent to the calendar year 2002; provided further, that in the distribution of such grant monies priority shall be given initially to municipalities and governmental bodies which have not previously received any monies, either through an appropriation or other such fiscal assistance from the state, to address debt service obligations relative to such pollution control technology improvements.

(g) The use by said corporation of monies to implement the provisions of this section shall be deemed to be an essential governmental function. Notwithstanding any general or special law to the contrary, the provisions of clause (a) of section 4A of this chapter shall apply to expenditures made from the fund; provided, however, that no such expenditure shall be deemed to involve a capital facility project; provided further, that no lease or license executed in furtherance of the public purpose and interests of the fund shall exceed 30 years in duration, and the duration and terms shall be developed in a manner consistent with good business practices; and provided further, that the



corporation shall take no action which contravenes the commonwealth's reversionary interest in any of its real property. The corporation, any purchasing cooperative established thereby, and all members of any such purchasing cooperative may participate in any energy-related purchasing, aggregating, or similar program established and operated by the Massachusetts health and educational facilities authority and such participation shall be deemed to be in furtherance of an essential governmental function.

(h) The provisions of clause (k) of section 4 of this chapter shall not apply to disbursements from the RET fund.

(i) The governor shall, from the recommendation submitted by the chairman of the board relating to clause (i) of said section 4, appoint an advisory committee to assist the corporation in matters related to the fund and in the implementation of the provisions of this section. Said advisory committee shall include not more than 15 individuals with an interest in matters related to the general purpose and activities of the fund and the knowledge and experience in at least one of the following areas: electricity distribution, generation, supply, or power marketing; the concerns of commercial and industrial ratepayers; residential ratepayers, including low-income ratepayers; economics, financial or investment consulting expertise relative to the fund; regional environmental concerns; academic issues related to power generation, distribution or the development or commercialization of renewable energy sources; institutions of higher education; municipal or regional aggregation matters; and renewable and clean energy issues. The board shall consult with said advisory committee in discharging its obligations under this section.

(j) The books and records of the corporation relative to expenditures and investments of monies from the fund shall be subject to a biennial audit by the auditor of the commonwealth.

(k) Beginning with the fiscal year ending on June 30, 1999, on or by August 15<sup>th</sup> of each year, the board, in conjunction with the advisory committee, shall annually submit to the governor, the joint committees on government regulations and energy, respectively, and the house and senate committees on ways and means a report detailing the expenditure and investment of monies from the fund over the previous fiscal year and the ability of the fund to meet the requirements and provisions of this section, and any recommendations for improving the ability of the board, the corporation, and the fund to meet said requirements and provisions.

Added by St. 1997, c. 164, § 68.





## **Appendix B.      Approved Grants and Loans through December 31, 2001**



# Approved Grants and Loans through December 31, 2001

Recipient	Description	Support Type	Amount
<b>Green Power Predevelopment Finance</b>			
Ameresco, Inc.	To examine the feasibility of utilizing landfill gas from Waste Management's Chicopee landfill to provide 4 to 6 MW (Phase 1) of generating capacity in 2002. Generating capacity may be expanded to 10 to 15 MW, based on gas availability.	Loan	\$150,000
City of Brockton	To assess the technical and financial feasibility of developing 5-10 MW of grid-connected PV arrays on two related brownfield sites in Brockton.	Grant	\$128,415
Community Energy, Inc.	To perform a variety of predevelopment work necessary to secure funding for the development of a 3 MW wind farm in Princeton.	Loan	\$90,574
Distributed Generation Systems	To resolve various siting and permitting issues for a wind farm at Brodie Mountain in Hancock and North Ashford with a planned capacity of 13 MW.	Loan	\$150,000
Reddington Mountain, LLC	To undertake various predevelopment activities related to the interconnection, permitting and approval of a 27 MW grid-connected wind farm on Reddington Mountain in Maine.	Loan	\$75,358
University of MA/Urban Harbors Institute	To undertake predevelopment activities necessary to establish a mix of solar, wind, and tidal grid-tied generating facilities on the Boston Harbor Islands.	Grant	\$150,000
	<b>SUBTOTAL</b>		<b>\$744,347</b>
<b>Green Power Consumer Aggregation</b>			
Barnstable County (Cape Light Compact)	To undertake research and planning regarding sites for green power generation, economic benefits of green market development, relevant local regulations, and supply and demand issues for green power within the existing Cape Light Compact Consumer Aggregation.	Grant	\$140,000
Center for Ecological Technology	To research and establish the organizational structure for a green power aggregation in the Berkshires, identify and education potential members, and identify and evaluate potential green power supplies.	Grant	\$110,000
City of Newton	To identify pre-qualified host sites for PV system installations as part of the Newton SUNERGY program. Activities will include conducting outreach and education; assessing demand for PV systems, assessing individual preferences with regard to systems and financing, identifying specific site owners who wish to install PV; providing	Grant	\$45,000





Recipient	Description	Support Type	Amount
	follow-up technical assistance to individuals and businesses; and tabulating results.		
Conservation Services Group	To develop an aggregation of faith-based facilities, through outreach for membership development, an education campaign, energy use analysis services, and market research.	Grant	\$50,000
Cooperative Development Institute	To conduct market research, business planning, outreach to existing cooperative members, including signing of letters of intent to purchase green electricity.	Grant	\$130,000
Cooperative Development Institute/Upepo	To develop a working model for the market penetration of a renewable energy service product for Boston urban communities of color	Grant	\$50,000
Massachusetts Energy Consumers Alliance	To conduct research, outreach and organizational planning to establish a green power aggregation for social/environmental organizations, businesses and communities, and their constituencies.	Grant	\$120,000
Massachusetts Municipal Association (MMA)	To educate member municipalities and assess members' interest in purchasing green power.	Grant	\$75,000
MHI, Inc.	To conduct outreach to members of HEFA's PowerOptions consortium, identify possible green energy suppliers, undertake an RFP process, and finalize a contract to supply green power offer to member institutions.	Grant	\$130,000
	<b>SUBTOTAL</b>		<b>\$850,000</b>
<b>Premium Power</b>			
Cambridge Savings Bank	To evaluate the feasibility of using fuel cells at the Cambridge Savings Bank Headquarters and selected branch locations in Massachusetts.	Grant	\$70,380
Harvard Medical School / Merck	To design a fuel cell system to provide premium power to two adjacent research centers currently under development in the Longwood Medical area in Boston and issue an RFP for system installation and operation.	Grant	\$150,000
Lavery Lohnes Properties	To assess the feasibility of using a fuel cell-based premium power system to provide electricity and heat at a proposed Internet Data Center to be developed at a Kendall Square site.	Grant	\$133,300
Nuvera Fuel Cells	To install and test prototype version of 5kW PEM fuel cell-based system developed by Nuvera Fuel Cells intended for applications in a decentralized telecommunications switchgear network owned by Verizon.	Loan	\$750,000





Recipient	Description	Support Type	Amount
Nuvera Fuel Cells	To install and test prototype version of 5kW PEM fuel cell-based system developed by Nuvera Fuel Cells intended for applications in a decentralized telecommunications switchgear network owned by Verizon.	Grant	\$750,000
U.S. Coast Guard	To install a 250kW molten carbonate fuel cell (MCFC) manufactured by FuelCell Energy at the U.S. Coast Guard Air Station in Bourne, MA.	Grant	\$406,000
	<b>SUBTOTAL</b>		<b>\$2,259,680</b>
<b>Green Buildings</b>			
Artists For Humanity	To assess the feasibility of incorporating green building practices in new headquarters.	Grant	\$20,000
Mount Wachusett Community College	To install a wood chip-fueled hydronic heating system and serve as a beta test site for a 500 kW gasifier co-generation system to be installed in 2003 or 2004.	Grant	\$750,000
New England Aquarium	To incorporate renewable energy in the design of a planned expansion	Grant	\$200,000
	<b>SUBTOTAL</b>		<b>\$970,000</b>
<b>Renewable Energy Industry Associations</b>			
Solar Energy Business Association of New England	To establish a professionally managed industry associations, participate in regulatory proceedings, and cooperate in planning process for Solar-to-Market initiative	Grant	\$400,000
<b>Waste-to-Energy Program</b>			
Acton	To reimburse the community for additional costs associated with the installation of pollution control equipment at contracted waste-to-energy facilities	Grant	779,009
Acushnet	"	Grant	105,914
Agawam	"	Grant	93,028
Andover	"	Grant	1,009,046
Arlington	"	Grant	1,973,561
Attleboro	"	Grant	206,273
Auburn	"	Grant	169,521
Barnstable	"	Grant	2,563,972

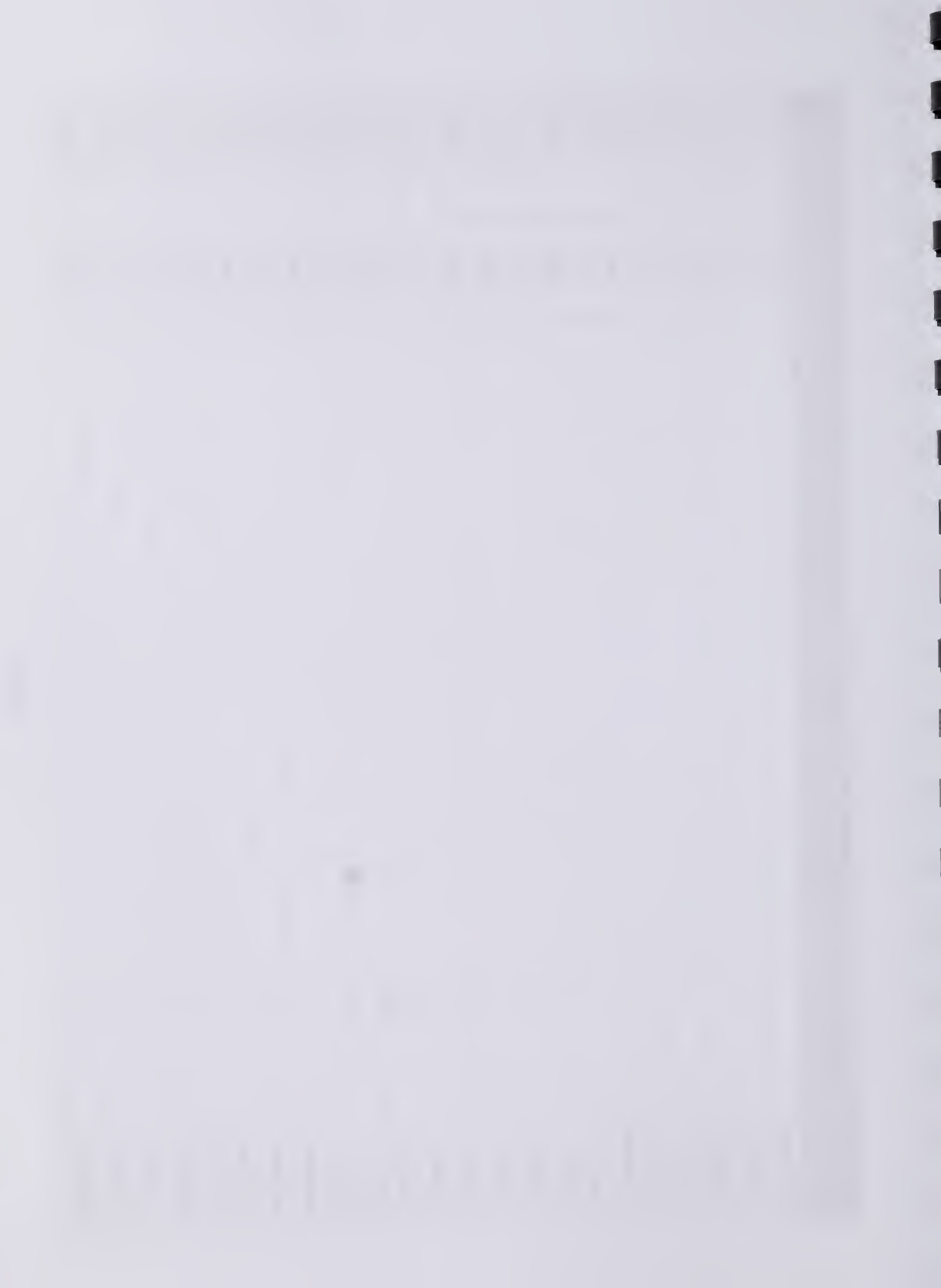


Recipient	Description	Support Type	Amount
Bedford	"	Grant	467,373
Bellingham	"	Grant	237,950
Belmont	"	Grant	1,261,307
Beverly	"	Grant	563,890
Bourne	"	Grant	133,013
Boxborough	"	Grant	106,530
Braintree	"	Grant	804,294
Brewster	"	Grant	364,908
Burlington	"	Grant	913,587
Canton	"	Grant	432,739
Carlisle	"	Grant	158,525
Chatham	"	Grant	379,329
Chelsea	"	Grant	452,072
Cohasset	"	Grant	91,165
Dennis	"	Grant	726,019
Dighton	"	Grant	21,916
Dover	"	Grant	63,429
Dracut	"	Grant	933,351
Duxbury	"	Grant	290,132
East Brookfield	"	Grant	22,603
East Longmeadow	"	Grant	45,480
Eastham	"	Grant	237,377
Everett	"	Grant	717,917





Recipient	Description	Support Type	Amount
Fairhaven	"	Grant	370,628
Falmouth	"	Grant	1,097,870
Franklin	"	Grant	254,281
Freetown	"	Grant	66,523
Grafton	"	Grant	161,610
Greenfield	"	Grant	58,598
Groton	"	Grant	7,898
Halifax	"	Grant	29,468
Hamilton	"	Grant	256,444
Hanover	"	Grant	257,841
Hanson	"	Grant	189,902
Harwich	"	Grant	438,792
Haverhill	"	Grant	4,342,519
Heath	"	Grant	2,654
Holden	"	Grant	183,647
Holliston	"	Grant	148,896
Holyoke	"	Grant	85,392
Hopedale	"	Grant	55,603
Hopkinton	"	Grant	127,140
Kingston	"	Grant	246,754
Lakeville	"	Grant	30,764
Lawrence	"	Grant	226,746
Lexington	"	Grant	934,581

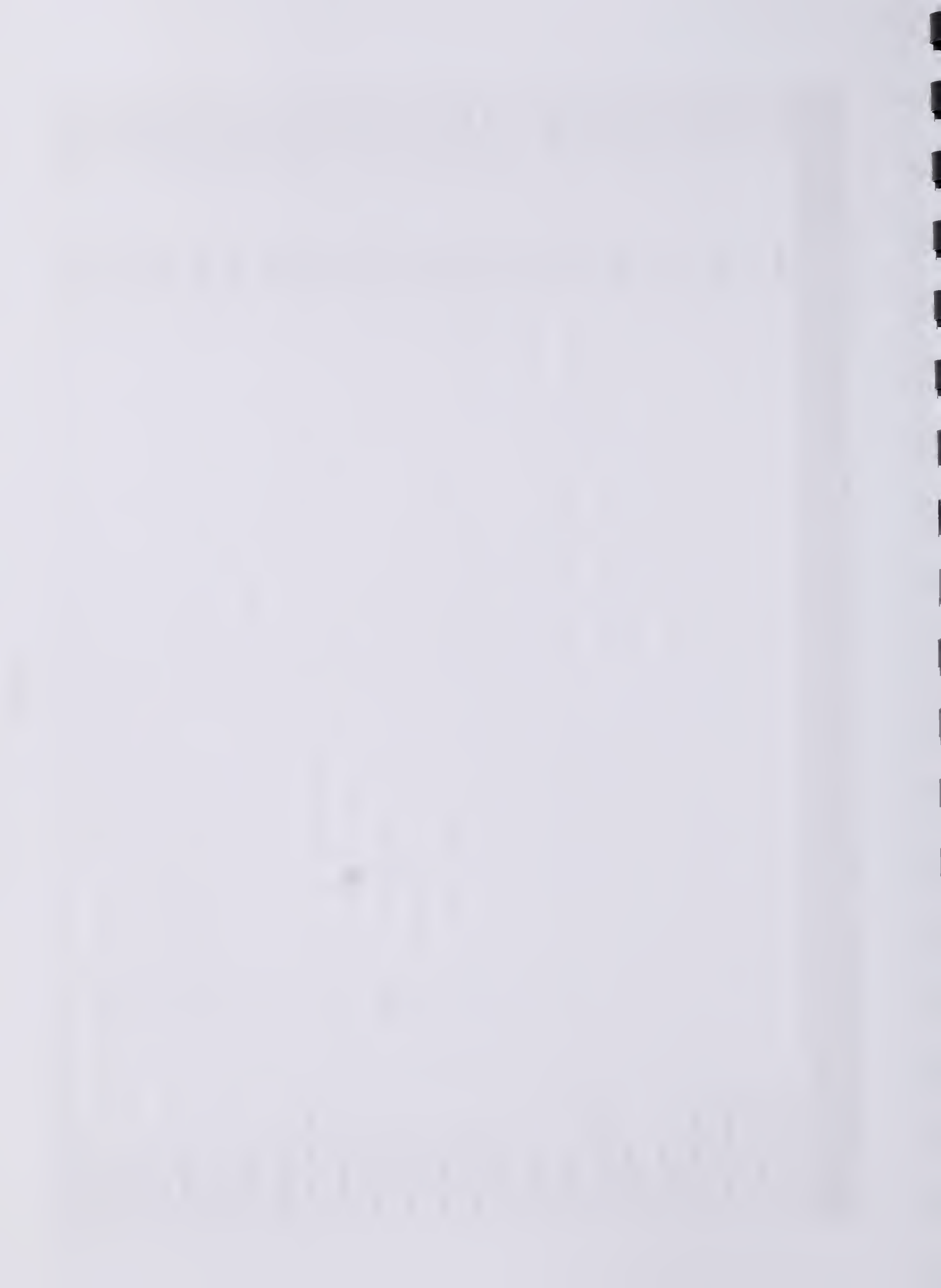


Recipient	Description	Support Type	Amount
Lincoln	"	Grant	195,265
Littleton	"	Grant	8,775
Longmeadow	"	Grant	48,581
Ludlow	"	Grant	74,422
Lynn	"	Grant	1,351,336
Malden	"	Grant	820,010
Manchester-by-the-Sea	"	Grant	215,111
Martha's Vineyard (Aquinnah, Chilmark, Edgartown, and West Tisbury)	"	Grant	290,583
Mashpee	"	Grant	390,308
Mattapoisett	"	Grant	64,147
Maynard	"	Grant	91,259
Medfield	"	Grant	159,660
Medway	"	Grant	129,259
Melrose	"	Grant	345,516
Mendon	"	Grant	36,023
Middleboro	"	Grant	144,165
Milford	"	Grant	232,271
Millis	"	Grant	50,150
Millville	"	Grant	29,384
Natick	"	Grant	205,120
Needham	"	Grant	204,131
Newton	"	Grant	463,319
Norfolk	"	Grant	20,259

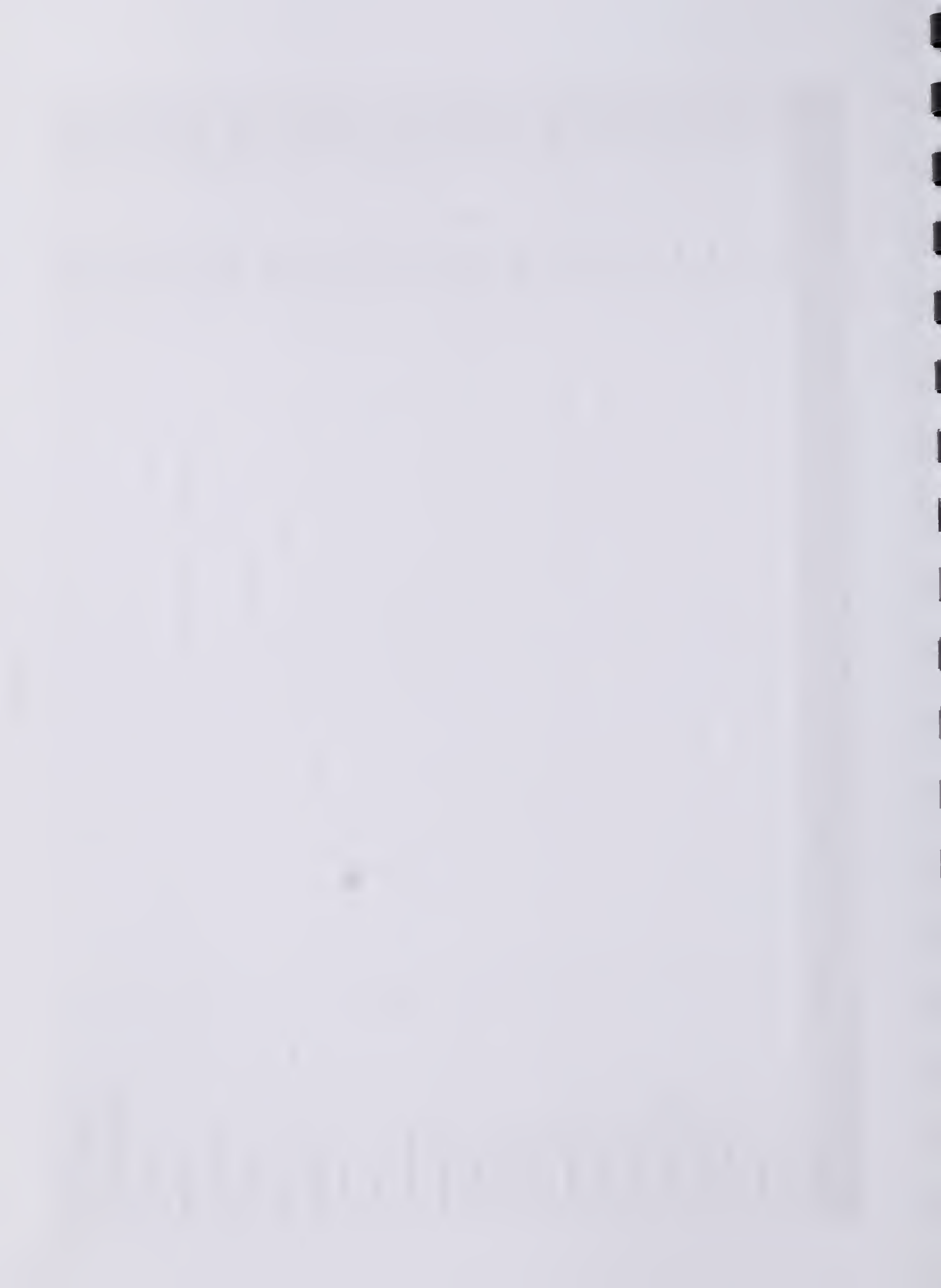


Recipient	Description	Support Type	Amount
North Andover	"	Grant	682,566
North Reading	"	Grant	430,222
Northborough	"	Grant	158,502
Northbridge	"	Grant	121,490
Norwell	"	Grant	225,508
Orleans	"	Grant	326,216
Otis Air Base	"	Grant	109,787
Oxford	"	Grant	180,003
Paxton	"	Grant	50,856
Peabody	"	Grant	1,595,168
Pembroke	"	Grant	372,437
Pittsfield	"	Grant	574,560
Plymouth	"	Grant	201,771
Plympton	"	Grant	38,733
Princeton	"	Grant	51,563
Provincetown	"	Grant	284,853
Randolph	"	Grant	303,679
Reading	"	Grant	242,467
Revere	"	Grant	845,713
Rockland	"	Grant	122,781
Rockport	"	Grant	12,668
Rutland	"	Grant	71,651
Sandwich	"	Grant	589,883





Recipient	Description	Support Type	Amount
Saugus	"	Grant	454,333
Sharon	"	Grant	443,540
Sherborn	"	Grant	59,332
Shrewsbury	"	Grant	279,709
Southborough	"	Grant	124,315
Southwick	"	Grant	41,346
Spencer	"	Grant	279,709
Springfield	"	Grant	599,927
Stoneham	"	Grant	278,837
Stoughton	"	Grant	516,296
Sudbury	"	Grant	24,556
Swampscott	"	Grant	169,727
Tewksbury	"	Grant	886,606
Truro	"	Grant	118,807
Upton	"	Grant	52,269
Wakefield	"	Grant	272,776
Walpole	"	Grant	214,726
Waltham	"	Grant	1,364,920
Watertown	"	Grant	1,332,410
Wellfleet	"	Grant	61,771
Wenham	"	Grant	118,668
West Bridgewater	"	Grant	139,459
West Newbury	"	Grant	130,313



Recipient	Description	Support Type	Amount
West Springfield	"	Grant	89,927
Westborough	"	Grant	339,380
Westford	"	Grant	531,750
Weston	"	Grant	118,664
Westwood	"	Grant	211,901
Wilbraham	"	Grant	35,144
Wilmington	"	Grant	727,179
Winchester	"	Grant	1,014,869
Winthrop	"	Grant	278,837
Worcester	"	Grant	1,493,420
Wrentham	"	Grant	227,146
Yarmouth	"	Grant	1,615,353
	<b>SUBTOTAL</b>		<b>\$53,709,834</b>
	<b>TOTAL GRANTS AND LOANS</b>		<b>\$58,933,856</b>





## **Appendix C.      IRS Private Letter Ruling – Green Power Premiums**



# Internal Revenue Service

*Department of the Treasury*

Index Numbers: 7701.20-00  
0170.07-05

*Washington, D.C.*

Mr. Philip F. Holahan  
Deputy Director  
Massachusetts Renewable Energy  
Trust Fund  
Seventy Five North Drive  
Westborough, MA 01581-3340

Person to Contact:  
Carolyn Cook (ID# 50-01497)  
Telephone Number:  
(202) 622-6010  
Refer Reply to:  
CC:TE/GE:EO2 PLR-107386-01  
Date:  
July 3, 2001

## LEGEND

Fund	=	Massachusetts Renewable Energy Trust Fund
Corporation	=	Massachusetts Technology Park Corporation EIN: 04-2773673
State	=	Massachusetts
Act <u>A</u>	=	Massachusetts General Laws ch. 40J (Law. Co-op. 1993 & Supp. 2001)
Act <u>B</u>	=	Massachusetts General Laws ch. 25 § 20 (Law. Co-op. 1996 & Supp. 2001)
year <u>a</u>	=	1982
year <u>b</u>	=	1984
year <u>c</u>	=	1991
year <u>d</u>	=	1997
<u>e</u>	=	\$ 20,000,000
<u>f</u>	=	\$ 0.0005
<u>g</u>	=	\$ 0.00025
<u>h</u>	=	\$ 150,000,000
<u>i</u>	=	\$ 50,000,000



PLR-107386-01

Program = Massachusetts Cleaner Energy Choice Program

Dear Mr. Holahan:

This is in reply to a letter from your representative dated January 26, 2001, requesting a ruling that Fund is an integral part of State and that certain payments to Fund made by consumers pursuant to Program will be deductible by them as charitable contributions under § 170 of the Internal Revenue Code.

### FACTS

Corporation was created in year a by Act A. Its purpose, as originally enacted, was to establish and operate one or more educational centers. The centers were intended to provide advanced education and practical training in emerging areas of science and technology in order to satisfy the education and employment needs of the state.

According to Act A, Corporation is a body, politic and corporate. It is placed in State's department of economic development but is not subject to the supervision or control of this department. Instead, Act A provides that Corporation is governed by a board of directors which consists of three state officials, four members selected from a list of persons nominated by the State legislature and sixteen members appointed by the governor. Any director may be removed by the governor for cause. With certain exceptions, the state statute regulating the conduct of public officials and employees applies to the directors, officers and employees of Corporation. In addition, the State statute governing public authorities and public agencies with respect to fraud and waste apply to Corporation.

In year b, Act A was amended to provide \$ e in state funds as State's contribution to the first education center established by Corporation. The books and records of Corporation are subject to an annual audit by the auditor of State. Act also requires Corporation to submit an annual report to the State legislature.

In year c, Act A was amended again. These amendments changed the purpose of Corporation. They directed Corporation to make the education center self-sufficient of regular, annual public maintenance funding. Instead, they authorized Corporation to aggressively use the resources of the center to directly support technology firms to maintain, expand and locate their business activities with the state, thereby increasing employment opportunities for the citizens of the state. The year c amendments also contained provisions allowing the formation of one or more technology partnerships with interested industrial firms and universities, the federal government and venture capital firms for the purpose of fully exploiting the substantial resources of the education





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centers. Such technology partnerships may involve the lease or licensing of all or part of the facilities, intellectual property or related resources, the furnishing of design and/or fabrication services, cooperative technology development and technology-sharing arrangements. Included in the amendments made to Act A in year c was a provision requiring that all income of Corporation be held and applied solely to accomplish the essential governmental functions of Corporation. In addition, the amendments include a provision that no income of Corporation shall accrue to any private individual or organization, and that upon dissolution of Corporation all of its assets shall be returned to the State.

## Fund

Fund was created pursuant to an amendment to Act A in year d. Fund is a separate trust fund set up on the books of Corporation. Corporation is required to credit to Fund all amounts collected pursuant to Act B, also enacted in year d, and any income derived from the investment of amounts credited to Fund. All amounts credited to Fund are to be held in trust and used solely for activities consistent with the public purpose of Fund. The purpose of Fund is to promote the availability and use of renewable energy. Renewable sources are certain sources other than coal, oil, natural gas except when used in fuel cells, and nuclear power. According to Act A, as amended in year d, Fund is to accomplish its purpose by, among other things, the stimulation of increased public and private sector investment, and the stimulation of entrepreneurial activities in these and related enterprises, institutions, and projects. In furtherance of these purposes the board of Corporation is permitted to expend monies from the fund to make grants, contracts, loans and equity investments or rebates to customer or take any other actions it deems appropriate.

The governor of State shall, from the recommendation submitted by the chairman of the board of Corporation, appoint an advisory committee to assist Corporation in matters related to Fund. The advisory committee includes no more than 15 individuals with an interest in and knowledge and experience in related areas. The board shall consult with the advisory committee in discharging its obligations with respect to Fund. The books and record of Corporation relative to expenditures and investments of monies from Fund are subject to a biennial audit by the auditor of State. The board of Corporation, in conjunction with the advisory committee, is required to annually submit to the governor, to certain state committees, and to the state legislature, a report detailing the expenditure and investments of monies from Fund, as well as any recommendations for improving the ability of the Corporation, the board of Corporation, and Fund to meet the requirements and provisions of section of Act relating to Fund.

The board of Corporation is required, in consultation with the State division of energy and the advisory committee of Fund, to adopt a plan for the application of Fund to support a renewable energy program, subject to periodic revision by the board, that



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ensures the Fund will be employed to provide financial and non-financial resource to overcome barriers facing renewable energy enterprises, institutions and projects. Subject to the approval of the board of Corporation, investment activity of monies from Fund may include an equity fund, to provide risk capital to renewable energy enterprises, institutions, and projects.

In State, customers obtain electricity at the retail level either from investor owned utility companies or from municipally owned plants. The municipally owned plants are subject to substantially less state regulation. Act A, as amended in year d, was enacted to replace certain privileges enjoyed by investor owned utility companies in State under the prior regulatory system. Pursuant to Act B, certain charges are collected by the investor owned utility distribution companies and remitted to Corporation which deposits the charges into Fund. Corporation is charged with administering Fund consistent with the public purposes for which the charges were enacted, as provided in Act B.

The relevant provision of Act B imposes two charges. The first charge, the renewable energy charge, is approximately \$ f per kilowatt hour. Its purpose is to support the development and promotion of renewable energy projects in accordance with Act A. The second charge, the waste-to-energy charge, is \$ g per kilowatt hour of electricity. Its purpose is to provide grants to municipalities and certain other entities with existing renewable energy facilities that use waste-to-energy technology in municipal solid waste plants to pay for pollution control technology or to close the facility. Fund represents that the renewable energy charge is expected to generate approximately \$ h over the first five years, and the waste-to-energy charge is expected to generate approximately \$ i. Act A provides that the waste-to-energy charge must be especially segregated in Fund and used only for the purposes specially designated by Act A for this charge. Although the charges are imposed by the State legislature on the customers of investor owned utilities and, in certain cases, on the customers of municipally owned plants, in practice, the charges falls only on the customers of investor owned plants. These charges do not constitute fees in exchange for services.

Fund established Program to support and encourage the development of power from renewable sources. Fund represents that under Program, consumers make donations to Fund on their monthly electric statements. In addition to their payment for the billed cost of standard power for their own account, a consumer will be able to elect to donate to the Fund an amount equal to the incremental cost of a corresponding amount of various types of power from renewable sources. Alternatively, the consumer's monthly statement will indicate that they can donate to Fund by overpaying their bills by \$1, \$5, \$10 or more with the amount designated going to Fund. These amounts are collected by the utility company and transferred to Corporation on a monthly basis for deposit in Fund.





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Fund represents that it will make payments to certain qualifying consumers on the condition that they agree to purchase power from renewable sources. The amount of the payment corresponds to the incremental cost of the type of renewable source energy they choose to receive from Program. In fact, the qualifying consumers receive the same power at the same rates whether or not they receive a payment as a qualifying consumer from Program. Due to the nature of the power grid, consumers who pay for renewable power do not necessarily actually receive power from renewable sources because electricity delivered to customers cannot be physically traced to a specific generation asset. When customers buy a specific, grid-delivered power product they do not physically receive specific electrons. Instead, their generator of choice simply adds the electrons demanded to the entire power pool, which are then delivered to all customers indiscriminately. Thus, the sole consequence of a renewable source purchase by a qualifying consumer is to cause more renewable energy to be added to the pool of energy available to everyone through the power grid.

## LAW & ANALYSIS

### Integral Part

Generally, if income is earned by an enterprise that is an integral part of a state or political subdivision of a state, that income is not taxable in the absence of specific statutory authorization to tax that income. See Rev. Rul. 87-2, 1987-1 C.B. 18; Rev. Rul. 71-131, 1971-1 C.B. 28; Rev. Rul. 71-132, 1971-1 C.B. 29.

In Maryland Savings-Share Ins. Corp. v. United States, 308 F. Supp. 761 (D. Md. 1970), rev'd on other grounds, 400 U.S. 4 (1970) (MSSIC), the State of Maryland formed a corporation to insure the customer accounts of state chartered savings and loan associations. Under MSSIC's charter, the full faith and credit of the state was not pledged for MSSIC's obligations. Only three of eleven directors were selected by state officials. The district court rejected MSSIC's claim of intergovernmental tax immunity because the state made no financial contribution to MSSIC and had no present interest in the income of MSSIC. Thus, the imposition of an income tax on MSSIC would not burden the State of Maryland. Although the Supreme Court reversed the lower court on other grounds it agreed with the lower court's analysis about the treatment of state created enterprises.

In State of Michigan and Michigan Education Trust v. United States, 40 F. 3d 817 (6<sup>th</sup> Cir. 1994), rev'd 802 F. Supp. 120 (W.D. Mich. 1992), the court held that the investment income of the Michigan Education Trust (MET) was not subject to current taxation under section 11(a). The court's opinion is internally inconsistent because it concludes that MET qualifies as a political subdivision of the State of Michigan (Id. at 825), that MET is "in a broad sense" a municipal corporation (Id. at 826), and that MET is in any event an integral part of the State of Michigan (Id. at 829). Moreover, the



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court's reliance on the factors listed in Rev. Rul. 57-128, 1957-1 C.B. 311, to reach its conclusion is misplaced. The revenue ruling applies to entities that are separate from the state. The factors in the revenue ruling do not determine whether an enterprise is considered to be a separate entity or an integral part of the state.

Section 301.7701-1 et seq. of the Procedure and Administration Regulations, the so-called "check-the-box" regulations, support the position that an entity that is recognized as separate from a state or political subdivision for local law purposes may still be an integral part of that state political subdivision. Section 301.7701-1(a) provides, in part, that an entity formed under local law is not always recognized as a separate entity for federal tax purposes. For example, an organization wholly owned by a State is not recognized as a separate entity for federal tax purposes if it is an integral part of the State.

In determining whether an enterprise is an integral part of the state, it is necessary to consider all of the facts and circumstances, including the state's degree of control over the enterprise and the state's financial commitment to the enterprise.

#### Corporation

The control State exercises over Corporation is substantial. According to Act A, Corporation's board of directors consists of three state officials, four directors chosen from a list submitted by the legislature, and sixteen directors elected by the governor. The directors can be removed by the governor for cause, and are subject to many of the state statutes regulating the conduct of public employees. Corporation was created by state legislation and placed in the State department of economic development. The books and records of Corporation are subject to an annual audit by the auditor of State. Act A also requires Corporation to submit an annual report to the State legislature. The financial commitment State has made to Corporation is also substantial. In year b, State provided \$ e in state funds as State's contribution to the first education center established by Corporation. State's contribution to Corporation represents a substantial portion of the net worth of Corporation.

Accordingly, after considering the financial commitment that State has made to Corporation and the degree of control exercised over Corporation by State, we conclude that Corporation is an integral part of State.

#### Fund

The control State exercises over Fund is also substantial. Fund was created when the state legislature amended Act A, the statute which created Corporation. According to Act A, as amended, Fund is subject to the control of Corporation's board of directors. In addition, Fund has its own advisory board, consisting of fifteen members appointed by the governor. The board consults with the advisory committee



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in discharging its obligations with respect to Fund. The books and record of Corporation relative to expenditures and investments of monies from Fund are subject to a biennial audit by the auditor of State. The board of Corporation, in conjunction with the advisory committee, is required to submit to the governor, certain state committees, and the state legislature, a report detailing the expenditure and investments of monies from Fund. The financial commitment State has made to Fund is also substantial. State has assessed charges on the end users of electrical power distributed by private utility companies. The charge is not a fee in exchange for services. Fund is used for programs that benefit equally the entire populace of State. Approximately \$ h will be turned over to Corporation to deposit in Fund, as mandated by state legislation. This constitutes a substantial portion of Fund's net worth.

Accordingly, after considering the financial commitment that State has made to Fund and the degree of control exercised over Fund by State, we conclude that Fund is an integral part of State.

#### Section 170

Section 170(a)(1) of the Code provides, subject to certain limitations, a deduction for contributions or gifts to or for the use of organizations described in § 170(c), payment of which is made within the taxable year.

Section 170(c)(1) of the Code states that the term "charitable contribution" includes a contribution or gift to or for the use of a State, a possession of the United States, any political subdivision of a State or any possession of the United States, or the District of Columbia, but only if the contribution is made for exclusively public purposes.

In this case, consumers will make contributions or gifts to Fund pursuant to Program. Since Fund is an integral part of State, contributions or gifts to or for the use of Fund are to or for the use of an entity described in § 170(c)(1) of the Code. Accordingly, contributions or gifts to or for the use of Fund are to or for the use of State and, provided they are made for exclusively public purposes, are generally deductible under § 170(c)(1) to the extent otherwise allowed by § 170.

Except as expressly provided herein, no opinion is expressed or implied concerning the tax consequences of any aspect of any transaction or item discussed or referenced in this letter.

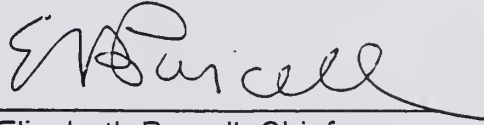




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This ruling is directed only to the taxpayer who requested it. Section 6110(k)(3) provides that this ruling may not be used or cited as precedent.

Sincerely, .

A handwritten signature in black ink, appearing to read "EPurcell", with a horizontal line extending from the end of the signature.

Elizabeth Purcell, Chief  
Exempt Organizations  
Branch 2  
Division Counsel/Associate  
Chief Counsel  
(Tax Exempt and Government  
Entities)

Enclosures:

Copy of this letter  
Copy for § 6110 purposes

CC: Allen Jones  
Director, Federal, State and Local Governments  
T:GE:FSL  
1111 Constitution Ave. NW  
Washington D.C. 20224





# Notice of Intention to Disclose

Taxpayer name	
Mailing date of this notice	JUL 12 2001
Last date to request IRS review	AUG 1 2001
Last date to request delay	SEP 10 2001
Last date to petition Tax Court	SEP 10 2001
Date open to public inspection	OCT 5 2001

Section 6110 of the Internal Revenue Code provides that copies of certain rulings, technical advice memoranda, and determination letters will be open to public inspection after deletions are made. Rulings and technical advice memoranda will be open to public inspection in the Freedom of Information (FOI) Reading Room, 1111 Constitution Avenue, N.W., Washington, D.C. 20224, where they may be read and copied by anyone interested.

In accordance with section 6110, we intend to make the enclosed deleted copy of your ruling open to public inspection. We made the deletions indicated in accordance with section 6110(c), which requires us to delete:

1. The names, addresses, and other identifying details of the person the ruling pertains to, and of any other person identified in the ruling (other than a person making a "third party communication" - see back of this notice).
2. Information specifically authorized under criteria established by an Executive Order to be kept secret in the interest of national defense or foreign policy, and which is in fact properly classified under such Executive Order.
3. Information specifically exempted from disclosure by any statute (other than the Internal Revenue Code) which is applicable to the Internal Revenue Service.
4. Trade secrets and commercial or financial information obtained from a person that are privileged or confidential.
5. Information which would constitute a clearly unwarranted invasion of personal privacy.
6. Information contained in or related to examination, operating, or condition reports prepared by, or for use of an agency that regulates or supervises financial institutions.
7. Geological and geophysical information and data (including maps) concerning wells.

These are the only grounds for deleting material. We made the indicated proposed deletions after considering any suggestions for deletions you may have made prior to issuance of the ruling.

**If You Agree** with the proposed deletions you don't need to take any further action. We will place the deleted copy in the National Office FOI Reading Room on the "Date Open to Public Inspection" shown on this notice.

**If You Disagree** with the proposed deletions, please return the deleted copy and show, in brackets, any additional information you believe should be deleted. Include a statement supporting your position. Only material falling within the seven categories listed above may be deleted. Your statement should specify which of these seven categories is applicable with respect to each additional deletion you propose. Send your deleted copy and statement to:

Internal Revenue Service  
Attention: CC:PA:T  
Ben Franklin Station  
Post Office Box 7604  
Washington, DC 20044

For Paperwork Reduction Act information, see back of notice.





It must be postmarked no later than the "Last Date to Request IRS Review" shown on this notice. We will give your submission careful consideration. If we feel we cannot make any or all of the additional deletions you suggest, we will so advise you no later than 20 days after we receive your submission. You will then have the right to file a petition in the United States Tax Court if you disagree with us. Your petition must be filed no later than the "Last Date to Petition Tax Court" shown on this notice, which is 60 days after the mailing date of this notice. If a petition is filed in the Tax Court, the disputed portion(s) of the ruling won't be placed in the Reading Room until after a court decision becomes final.

If no petition is filed in the Tax Court, the deleted copy of your ruling will be made open to public inspection on the date shown on this notice. If the transaction to which the ruling relates will not be completed by then, you may request a delay of public inspection.

#### **Request for Delay of Public Inspection**

You may request a delay of public inspection of up to 90 days, or 15 days after the transaction is completed, whichever is earlier. The request for delay must be received by the IRS no later than the "Last Date to Request Delay" shown on this notice, which is 60 days after the mailing date of this notice. Send your request for delay to:

**Internal Revenue Service**  
Attention: CC:PA:T  
Ben Franklin Station  
Post Office Box 7604  
Washington, DC 20044

You may request a second delay of up to an additional 180 days (or 15 days after the completion of the transaction, whichever is earlier) if the transaction is not completed by the end of the original delay period and if good cause exists for additional delay. We must receive a request for a second delay at the above address at least 30 days before the original delay period ends.

#### **Additional Disclosure**

After the deleted copy of your ruling is placed in our Reading Room, any person may request us to make additional portions of the ruling open to public inspection. If we receive a request that involves disclosure of names, addresses, or taxpayer identifying numbers, we will deny the request and you won't be contacted. If that request involves disclosure of anything other than names, addresses, or taxpayer identifying numbers, we will contact you before taking action.

#### **Third Party Communications**

The enclosed deleted copy of your ruling may contain the notation "Third Party Communication." This indicates that IRS received a communication (written or oral) regarding your ruling request from a person outside the IRS (other than you or your authorized representative). The date of the communication and the category of the person making the contact (such as "Congressional" or "Trade Association") will be indicated.

If You Have Any Questions regarding this notice, please contact:

**Internal Revenue Service**  
Attention: CC:PA:T  
Ben Franklin Station  
Post Office Box 7604  
Washington, DC 20044  
(202) 622-7570

**Paperwork Reduction Act Notice** —You are not required to provide the information requested on a form that is subject to the Paperwork Reduction Act unless the form displays a valid OMB control number. Books or records relating to a form or its instructions must be retained as long as their contents may become material in the administration of any Internal Revenue law. Generally, tax returns and return information are confidential, as required by Code section 6103. The time needed to provide information if you disagree with the proposed deletions will vary depending on individual circumstances. The estimated average time is 30 minutes. If you have comments concerning the accuracy of this time estimate or suggestions for making this notice simpler, we would be happy to hear from you. You can write to the Tax Forms Committee, Western Area Distribution Center, Rancho Cordova, CA 95743-0001. Do not send your submission to this address. Instead, send it to: **Internal Revenue Service**, Attention: CC:PA:T, Ben Franklin Station, Post Office Box 7604, Washington, DC 20044



## **Appendix D. RET Strategic Direction Statement (without appendices)**



# **A letter to the MTPC Board of Directors**

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October 25, 2000

To MTPC Board of Directors:

We are embarking on a new path in Massachusetts. With passage of the Restructuring Act and recent technological advances, we now have a tremendous opportunity to shift toward a greater reliance on renewable resources to meet our energy needs in the Commonwealth.

Generating electricity by means of photovoltaic, wind turbine, biomass, fuel cell and other renewable energy technologies will result in a cleaner environment, improved health, and greater economic well being for the citizens of the Commonwealth.

Photovoltaic, fuel cell and wind technologies offer opportunities for homeowners, businesses, institutions and municipalities to explore distributed generation options. Distributed Generation offers the promise of providing electricity in fundamentally different ways — dispersed, on-site, small-scale sources of electricity capable of providing power to individual buildings, communities and the grid.

Wind power generation has doubled over the past decade making it the fastest growing energy sector in the world. Massachusetts has significant sources of wind energy. The Trust will explore opportunities to tap that potential.

At the heart of this new energy system is consumer choice – individuals and businesses now have the chance to purchase electricity and/or generate electricity on their own based on their assessment of energy sources, reliability, service, relative prices and other factors. Harnessed appropriately, consumer choice can be a powerful force for achieving important environmental and economic goals.

Recognizing the enormous promise of renewable energy, the Legislature established the Massachusetts Renewable Energy Trust Fund and charged the Massachusetts Technology Park Corporation (MTPC) with responsibility for advancing the public interests with respect to renewable energy here in the Commonwealth. MTPC does not take this trust lightly. We have a fiduciary responsibility to ensure that the fund is invested in ways that further the public purpose. Every action taken by MTPC should and will be considered within this context.

The strategy presented in this document reflects the views of numerous members of the community as well as a careful, objective analysis of the prospects for renewable energy in the Commonwealth. Built around a portfolio of renewable energy technologies, applications and initiatives, the strategy is intended to be flexible. We will learn by doing, adjusting our approach as we go in light of actual experience and ongoing input from key stakeholders – consumers, renewable energy companies, electricity suppliers, and government officials.





Finally, we view the creation of the Trust as a vehicle that can help educate us all to be smarter users of electricity. By expanding our use of renewables, as we become more efficient users of electricity where we live, work and play, we can provide one of the most powerful examples to date of how and economic and environmental goals can and *must* converge.

We appreciate the responsibility entrusted to us by the Legislature and approach the job ahead with great enthusiasm.

Sincerely,

Joseph Alviani



# Executive Summary

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## A new era for renewable energy

The Restructuring Act of 1997 ushered in a new era in the electric utility industry.<sup>1</sup> Consumers in competitive service territories now have the opportunity to choose their electricity suppliers based on energy sources, reliability, service, relative prices and other factors. The establishment of a competitive market based on consumer choice is seen as a necessary ingredient in efforts to lower energy rates, enhance energy reliability, and provide a cleaner environment in the Commonwealth.

As an integral part of the legislation, the Act created the Massachusetts Renewable Energy Trust Fund ("the Trust") to help the Commonwealth shift toward greater reliance on renewable energy resources to meet its energy needs and to spur the development of the renewable energy sector as an important source of future economic growth in Massachusetts. The Act charged the Massachusetts Technology Park Corporation (MTPC) with responsibility for administering the fund and advancing the public interest.

This document outlines the *initial* strategy that the MTPC intends to pursue to accomplish this legislative mandate. It is based on the best information available at this time and is designed to provide the flexibility necessary to respond to lessons learned and changing conditions. Specific initiatives will be refined over time as markets evolve, new information comes to light and a consensus emerges on appropriate directions.

## Prospects for renewable energy in Massachusetts

- **Renewable energy technologies vary in terms of maturity and potential application.** The Restructuring Act delineates a broad range of eligible renewable energy technologies. Some of these technologies, such as hydroelectric power, waste to energy, and landfill gas, are mature technologies that are already in widespread commercial use. Others are in early stages of commercialization or still in development. Each has certain characteristics that make it more or less suitable for different applications.
- **The use of renewable energy technologies in *central power generation* has potential, but significant hurdles must be overcome in order to develop a sustainable, competitive green power market in the Commonwealth.** With the exception of hydroelectric power, which has been developed extensively in the region, the relatively high cost of renewable energy has hindered the development of major renewable energy generating facilities for grid power in Massachusetts and elsewhere. However, costs are coming down to competitive levels, particularly for electricity generated with wind turbines. At the same time, there is growing evidence that some consumers may be willing to pay more for renewable energy. Still, the green power market is unlikely to develop until fully

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<sup>1</sup> Chapter 164 of the Acts of 1997, entitled "An Act Relative to Restructuring the Electric Utility Industry in the Commonwealth, Regulating the Provision of Electricity and Other Services, and Promoting Enhanced Consumer Protections Therein" was enacted on November 25, 1997.





functioning competitive markets are established in the Commonwealth. While the number of customers that elect to switch electricity suppliers is likely to increase in the next few years, major residential markets will be delayed until the price for standard and default service increases significantly. At that point, Massachusetts is likely to see the emergence of green power suppliers offering pure and blended green products in efforts to be competitive with conventional power suppliers. As the overall competitive market heats up, however, the green power market may still be constrained by other factors, including limited consumer awareness and government regulations.

- **Using renewable energy technologies in *distributed generation* holds bright promise in Massachusetts and elsewhere, but barriers exist to wide-scale adoption.** When most people think about the promise of energy produced through renewable resources they envision the use of these technologies as a replacement for large-scale generating plants fueled by combustible materials such as coal, gas, or oil and fissile materials used in nuclear reactors. However, renewable energy technologies can also be deployed in small-scale distributed power generation systems. Distributed power generation refers to generating facilities that are located at or near end-use customers. The distributed power generation market includes four segments: green buildings, on-site premium power, grid enhancement, and off-grid remote. In many of these applications, current renewable energy technologies present a cost-effective alternative to electricity produced through conventional means in addition to providing environmental benefits. Still, limited awareness among potential consumers, the absence of hard technical and financial information, and problems providing financing to consumers hamper wide scale commercialization in these markets.
- **There is a small, but strong, base of renewable energy companies and institutions in the Commonwealth with potential for significant growth.** Most renewable energy firms in the Commonwealth are small, focusing on specific parts of the value added chain. These companies face significant barriers, including limited staff resources, low capitalization, and difficulties accessing financial markets. Massachusetts' colleges and universities are home to a number of faculty members active in the field of renewable energy as well as multiple centers performing research related to various forms of renewable energy. These and other research institutes in the Commonwealth play an important role in advancing an understanding of the technical, economic and political issues related to renewable energy. They also provide the training grounds for individuals interested in pursuing careers in related fields.



## Strategy for the Massachusetts Renewable Energy Trust Fund

MTPC will pursue the environmental, economic and other goals mandated in the Restructuring Act, and in doing so will ensure that the interest of consumers in the Commonwealth is the primary consideration in any investment decision. MTPC will use the Trust to achieve four related statutory objectives:

- Shift electric energy consumption in Massachusetts away from conventional energy resources to a greater reliance on energy generated from renewable resources,
- Increase electric generating capacity from renewable resources to meet the growing energy demands of consumers in Massachusetts while also encouraging the adoption of energy efficiency measures,
- Expand the renewable energy sector in Massachusetts, including system developers, manufacturers, equipment vendors, architects and engineers, service providers, and research organizations.
- Increase the overall level of economic activity related to renewable energy in the Commonwealth.

In working toward these objectives, MTPC will strike an appropriate balance between achieving near-term impacts and moving the Commonwealth toward a new energy paradigm in the future.

Investments undertaken to advance the goals articulated in the Restructuring Act will be informed and supported by certain underlying principles. These include the following: build on consumer choice as reflected in a willingness to pay for electricity generated from renewable resources; provide ongoing subsidies for renewable energy only to the extent that they further the public interest; leverage the Trust resources with investments by other private and public organizations; subject the Trust investments to systematic review based on explicit criteria; collaborate with stakeholders in designing and implementing specific initiatives; and emphasize learning by doing.

The initial strategy centers on five major initiatives: support the development of distributed power generation projects, support the development of the green power market, promote the development of the renewable energy sector, provide support to educational institutions for renewable energy programs, and pursue special opportunities as they arise. Each of these initiatives is summarized below:

- **Support the development of distributed power generation projects.** MTPC will use the Trust to accelerate the deployment of renewable energy technologies for distributed power generation in the Commonwealth. Given the technical characteristics and economics of different technologies, this initiative will focus on expanding the use of fuel cells and photovoltaic systems in premium power, green building, utility and off-grid applications. Within this initiative, MTPC will provide information, financing and technical assistance needed to promote the development of projects in Massachusetts. Financing will be made available on a competitive basis for different aspects of proposed projects, including initial





conceptualization, feasibility assessments, design and engineering, and system installation. All requests for financing of system installations will be subject to systematic review based on at least six criteria: potential public benefits, net cost per kWh, commercial potential, geographic location, leverage of the Trust financing, and contribution to the public debate. In addition to financing, where appropriate and to the extent practicable, MTPC will work with project developers and others to overcome barriers to the development of proposed projects.

Given the importance of providing hard data on actual performance, MTPC will undertake independent assessments of actual system performance, including net benefits to end-use customers. Based on demonstrated results, MTPC will work with interested parties to mount a campaign to provide needed information to consumers through a combination of meetings, seminars, workshops, conferences, and print and electronic media.

In keeping with the aims of this initiative, MTPC will develop its campus in Westborough as a laboratory to enhance energy efficiency and incorporate the best use of available renewable energy technologies. In addition to satisfying the organization's own energy needs, this effort will showcase renewable energy technologies and green building concepts to a broad local, national and international audience.

While developing its campus as a living laboratory and demonstration of the utilization of renewable technologies and energy efficiency, MTPC will also be a center for renewable energy policy and thought. MTPC will draw technologists, policy-makers, entrepreneurs, investors and educators from across the country and the world to discuss current experiences, best practices and scientific breakthroughs which might enhance an understanding of the potential for generating electricity from renewable resources and provoke further deployment of renewable energy technologies. Similarly, MTPC will use its campus to convene teachers and students to observe and learn firsthand from experts about the impact of renewable energy technology on the environment and the economy.

- **Support the development of the green power market.** MTPC will assume an active role in convening stakeholders and interested parties in order to build consensus on the actions needed to promote a green power market in Massachusetts that best serves public interests. The initiative will focus on increasing demand for renewable energy among consumers who are willing to pay a premium for electricity generated from renewable resources and also assuring the development of *new* generating facilities that utilize cost-effective renewable energy technologies. Efforts will center on crafting market-based solutions that serve the interests of consumers in the Commonwealth.

To advance this result, MTPC will undertake a broad set of interrelated activities that focus on boosting demand. It will explore different ways to tap the apparent willingness of some consumers to pay more for energy from renewable resources. The current approach appears to center on premium pricing. However, other options such as purchasing and production cooperatives, social investment bonds, and charitable trusts may be preferable or could complement this approach. Working with other stakeholders, MTPC will assess the relative merits of different avenues and help implement preferred solutions. In addition,





MTPC will work with existing and potential aggregators to gauge interest in renewable energy among their members, encourage public agencies to buy green power, and help negotiate appropriate service offerings with energy suppliers.

MTPC also plans to take steps to encourage the development of *new* renewable energy generating facilities. This will include documenting specific opportunities to develop wind projects in Massachusetts and other parts of the region as well as working with developers and community representatives to address siting and other issues that pose barriers to potential projects. In concert with financial institutions and other stakeholders, MTPC will examine and develop alternative financing mechanisms such as equity investments, bridge loans, and loan guarantees that can be used to support large-scale renewable energy projects. Finally, MTPC will actively participate in deliberations concerning settlement and disclosure rules, the renewable portfolio standard, net metering, product certification, and other regulations affecting the green power market.

- **Promote the development of the renewable energy sector.** MTPC will use the Trust to undertake initiatives to strengthen the capacity and promote the growth of companies, universities and other organizations that are involved in the renewable energy sector in Massachusetts. MTPC believes that collective actions can help companies and institutions reap greater benefits from growing markets in Massachusetts and the rest of the world. The strategy will focus on bringing different organizations together to address common needs and to take advantage of opportunities afforded by restructuring and changing market conditions. Where appropriate, MTPC will also intervene to assist individual enterprises that have the potential to grow and provide economic benefits to the citizens of the Commonwealth.

MTPC will work with renewable energy companies and institutions to identify and address needs that limit their ability to grow and succeed in the Commonwealth. While specific programs will be developed over time in response to expressed demand, it is anticipated that this may include activities in a number of areas such as assisting renewable energy companies to capture an increased share of growing export opportunities, launching business-to-business networks, promoting cooperative R&D efforts, establishing an investment fund for early stage renewable energy companies, and establishing and working with industry-led collaboratives such as the Massachusetts Fuel Cell Council.

- **Provide support to educational institutions for renewable energy programs.** In addition to supporting the installation and utilization of renewable energy technologies in schools, MTPC will also promote the incorporation of renewable energy science curricula in primary and secondary schools in Massachusetts and will establish a scholarship fund for advanced studies in fields related to renewable energy. MTPC will consult with educators and other stakeholders to identify and review what is currently available and help teachers throughout the Commonwealth incorporate appropriate curriculum in their classrooms. The Trust funding could be used for curriculum development, teacher training, purchase of classroom equipment and materials, and statewide student fairs and/or competitions.



To enhance the scholarship program for Massachusetts' students who choose to attend universities in the Commonwealth and to pursue studies related to renewable energy, MTPC will encourage local companies to provide internships for these students to reinforce academic instruction and help position them for careers in the field.

- **Pursue special opportunities.** Given the rapid evolution of energy markets and enabling technologies, MTPC will seek to identify and support new opportunities that further the goals articulated in the legislation. This may include the establishment of a Center for Renewable Energy on the MTPC campus in Westborough, large-scale demonstration sites for advanced renewable energy technologies, and incentives to attract major renewable energy companies to the state. Moreover, as warranted, MTPC may devote resources to test the feasibility of emerging renewable energy technologies such as solar thermal, wave and tidal, and ocean thermal as well as advanced storage and conversion technologies.

## **Governance and management**

The Legislature recognized that the MTPC was particularly well suited to administer the Trust given its existing charter, public-private Board composition, broad statutory powers, and proven track record. The MTPC Board of Directors will oversee the Trust. The Board of Directors consists of senior managers from industry, universities, and state government. The Board includes the Chairperson of the Board of Higher Education, Director of the Massachusetts Department of Economic Development and the Secretary of the Executive Office for Administration and Finance.

Pursuant to the enabling statute, the Governor has appointed an Advisory Committee of individuals from nominations submitted by the Chairperson of the MTPC Board of Directors to provide policy advice with respect to the Trust. The Advisory Committee will consist of individuals with knowledge and experience in matters related to renewable energy, economics, finance, consumer affairs, education, and other relevant areas.

MTPC has established a new operating division – Massachusetts Renewable Energy Collaborative (MREC) – to manage all initiatives associated with the Trust.





# 1 A new era for renewable energy

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A little less than three years ago, the Massachusetts Legislature enacted legislation to restructure the electric utility industry in the Commonwealth.<sup>2</sup> The Restructuring Act of 1997 ushered in a new era in the electric utility industry.

Prior to the Act, electric utilities were granted a *de jure* monopoly in their respective service territories. Utilities were responsible for the generation, transmission and distribution of energy to their customers with prices regulated by federal and state authorities. The Restructuring Act changed this structure in areas served by investor-owned utilities. It separated these functions and allowed consumers to choose from among a variety of competing electricity suppliers.<sup>3</sup>

Consumers in competitive service territories now have the opportunity to choose their electricity suppliers based on energy source, price, service, and other factors. The establishment of a competitive market based on consumer choice is seen as a necessary ingredient in efforts to lower energy rates, enhance energy reliability, and provide a cleaner environment in the Commonwealth.

As an integral part of the legislation, the Act created a fund – the Massachusetts Renewable Energy Trust Fund ("the Trust") – to help the State shift toward greater reliance on renewable energy resources to meet its energy needs and spur the development of the renewable energy sector as an important source of future economic growth in the Commonwealth. The Legislature recognized the tremendous opportunities afforded through an energy system based on renewable resources. By imposing a small surcharge on electricity sales, the Legislature created a fund that can be used to help realize broad environmental and economic goals.<sup>4</sup>

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<sup>2</sup> Chapter 164 of the Acts of 1997, entitled "An Act Relative to Restructuring the Electric Utility Industry in the Commonwealth, Regulating the Provision of Electricity and Other Services, and Promoting Enhanced Consumer Protections Therein" was enacted on November 25, 1997. (See Appendix A.) Two types of utilities have historically served Massachusetts: investor-owned utilities and publicly owned municipal lighting plants (MLPs). Section 34 of M.G.L. c. 164 confers upon cities and towns the authority to choose to "construct, purchase or lease, and maintain within its limits, one or more plants for the manufacture or sale of gas or electricity . . . for municipal use or for the use of its inhabitants." Major changes under the Restructuring Act deal principally with the segment of the industry owned and controlled by investor-owned utilities. In this regard, the term "competitive service territories" used in this document refers to areas in the Commonwealth that are served by the eight original investor-owned utilities as well as those MLP communities that elect to open the market to competition in the future. Under the Restructuring Act the transmission and distribution of power from the grid to individual customers will continue to be regulated.

<sup>3</sup> The Restructuring Act employs the term "ratepayers" to refer to electricity consumers. In this document, the term ratepayer and consumer are used interchangeably.

<sup>4</sup> The Act requires consumers in competitive service territories to pay a surcharge on each kilowatt-hour of electricity purchased. Under the legislation, the typical residential customer will contribute roughly 57 cents per month to the Trust over the first five years. The renewable energy surcharge is collected by distribution companies and transferred in whole to the Massachusetts Technology Park Corporation (MTPC). The surcharge applies to customers in competitive service territories, including customers of MLPs that have elected to open their service territories to competition or that supply generation service outside their service territories. The surcharge varies over time according to the following schedule:

Schedule of Renewable Energy Surcharge	1998	1999	2000	2001	2002	Beyond 2002
Renewable energy surcharge (¢/KWH)	0.075	0.100	0.125	0.100	0.075	0.050

It is expected that the surcharge will generate \$200 million over the first five years. Of this amount, roughly \$50 million is earmarked specifically for waste to energy projects in the Commonwealth.



Specifically, the Legislature charged the Massachusetts Technology Park Corporation (MTPC) with responsibility for achieving the public purpose mandated in the Act:

“The public purpose shall be to generate the maximum economic and environmental benefits over time from renewable energy to the ratepayers of the Commonwealth through a series of initiatives which exploits the advantages of renewable energy in a more competitive energy marketplace by promoting the increased availability, use, and affordability of renewable energy,... and by fostering the formation, growth, expansion, and retention within the Commonwealth of preeminent clusters of renewable energy and related enterprises, institutions, and projects, which serve the citizens of the Commonwealth.”

There are several elements of this statement that merit additional comment:

- Foremost, the Trust exists to benefit *consumers* in Massachusetts. These benefits are expressed in both *economic and environmental* terms. While the legislation establishes reductions in greenhouse gases and other pollutants as one of the goals of the Trust, it places equal importance on generating economic value in the form of additional employment and income in the state. These twin goals are at the core of everything that the Trust will do and for which it is ultimately accountable. Funds held in the Trust will be expended only if and to the extent it is determined that such expenditures will advance the public purposes established by the Legislature.
- In a related vein, the legislation recognizes the importance of fostering the growth of strong renewable energy *enterprises and institutions* in the Commonwealth. Changes in energy markets are giving rise to new business opportunities for companies, including generating companies, distributors, equipment manufacturers, system installation and maintenance firms, energy brokers and financial institutions. Evolving energy markets that are governed by customer choice will require viable companies that are capable of producing and marketing commercially acceptable products at prices that consumers are willing to pay and still yield an adequate return. In addition, universities, colleges and other organizations will need to continue to foster technological innovation and help meet growing demands for a skilled and well-prepared labor force.
- The legislation calls attention to the importance of *time* in any consideration of benefits that may accrue to consumers in the Commonwealth. The Trust is intended to generate returns in the near term, while simultaneously laying the foundation for substantial progress toward a new energy future. Put another way, the Legislature intended the Trust to capitalize on existing market opportunities, while helping to establish the infrastructure needed to support a growing, sustainable and competitive market for renewable energy in the future. Decisions regarding the best uses of the Trust need to take into account trade-offs between short-term, temporary gains and long-term, sustainable benefits.





- Finally, the legislation envisions that the Trust will be used to support a *series of initiatives*. The legislation grants MTPC significant latitude in determining how funds will be expended. The absence of a prescribed approach in the Act with respect to achieving stated goals is by design. The Legislature provided MTPC with considerable discretion on how best to use the Trust in recognition of the complexity of issues involved and the evolving nature of energy technologies and markets.

This document outlines the *initial* strategy that the MTPC intends to pursue to accomplish this legislative mandate.<sup>5</sup> It has been reformulated and refined in the three years since the legislation became effective.<sup>6</sup> The strategy is grounded, in part, on the results of two major projects undertaken by the MTPC. With major assistance provided by Arthur D. Little, Inc., the first project focused on a critical analysis of the current stage of development of renewable energy technologies and prospects for future advances.<sup>7</sup> The second project involved strategic planning efforts undertaken by MTPC in conjunction with Bain & Company and Nexus Associates, Inc. This included a thorough examination of existing and projected market opportunities for renewable energy. The strategy is also based on extensive discussions that MTPC has had with representatives of government agencies, power generators and suppliers, distribution companies, aggregators, renewable energy companies, consumer groups, and the broader community in Massachusetts and elsewhere. As such, it reflects the experiences of numerous individuals who have been involved in renewable energy programs established in other states and around the world.

The strategy presented in this paper is based on the best information available at this time and is designed to provide the flexibility necessary to respond to changing conditions. However, it is important to note that issues surrounding the best use of the resources made available through the creation of the Trust are complex and evolving. MTPC expects to refine the strategy through ongoing interactions with key stakeholders and in-depth analyses of actual results of the initiatives undertaken by the organization. Specific initiatives will be refined over time as markets evolve, new information comes to light and a consensus emerges on appropriate directions.

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<sup>5</sup> The legislation stipulates that a portion of the renewable energy charge (\$0.00025 per kWh) collected between March 1, 1998 and December 31, 2002 is to be used only for grants to municipalities with existing contracts with waste-to-energy (WTE) facilities. Specifically, these grants must be made to alleviate, to the extent possible, increased municipal payment obligations arising from "the installation of pollution control technology and the implementation of other operational improvements," or "the closure" of WTE facilities. As these funds are restricted to this sole purpose, they are not discussed in this document.

<sup>6</sup> While the legislation became effective in March 1998, MTPC made the decision to postpone the release of the plan and subsequent expenditures from the fund until a class action lawsuit challenging the constitutionality of the mandatory charges for energy efficiency and renewable energy was settled. The suit sought a declaratory judgment from the Supreme Judicial Court (SJC) against distribution companies, the Department of Telecommunications and Energy (DTE), Division of Energy Resources (DOER), and the Massachusetts Technology Park Corporation (MTPC). On April 19, 2000, the SJC ruled in favor of the defendants. The ruling is available on the MTPC website: [www.mtpc.org/massrenew/shear\\_apr19\\_00.htm](http://www.mtpc.org/massrenew/shear_apr19_00.htm)

<sup>7</sup> Copies of the Arthur D. Little study are available on the MTPC website: [www.mtpc.org/renew/energy.htm](http://www.mtpc.org/renew/energy.htm)





## 2 Prospects for renewable energy in the Commonwealth

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### 2.1 Renewable energy technologies vary in terms of maturity and potential application.

The Restructuring Act delineates a broad range of eligible renewable energy technologies.<sup>8</sup> Some of these technologies – hydroelectric power, biomass (waste to energy), and landfill gas – are mature technologies that are already in widespread commercial use. Others are in early stages of commercialization or still in development. Table 1 provides an overview of the renewable energy technologies included in the legislation. Each has certain characteristics – such as minimum efficient scale, efficiency, reliability, and costs – that make it more or less suitable for different applications.

When most people think about the promise of energy produced through renewable resources they envision the use of these technologies as a replacement for large-scale generating plants fueled by combustible materials such as coal, gas, or oil and fissionable materials such as the uranium used in nuclear reactors. However, renewable energy technologies can also be applied in small-scale distributed power generation systems. Distributed power generation refers to scalable generating facilities that are located at or near end-use customers. These facilities can be located on either side of the meter or entirely disconnected from the power grid. In contrast to central power generation, where the value of renewable energy is defined primarily in terms of public benefits (particularly environmental), the value of renewable energy in distributed power generation rests in both public *and* private benefits.

The potential market for renewable energy in both central and distributed power generation is discussed below. The assessment of prospects for renewable energy in the Commonwealth begins with an examination of the potential for shifting toward a greater reliance on energy produced from renewable resources in central power generation. The discussion then turns toward an assessment of the potential for expanding the use of renewable energy technologies in distributed power generation. Four segments of the distributed power generation market are considered: green buildings, on-site premium power, grid enhancement, and off-grid remote.<sup>9</sup> The analysis presented in this chapter focuses on technologies that are currently suited to conditions in the Commonwealth and have near term market potential.<sup>10</sup>

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<sup>8</sup> Technologies defined by law as renewable and, therefore, eligible for support are: solar photovoltaic and solar thermal electric energy; wind energy; ocean thermal, wave, or tidal energy; landfill gas; waste-to-energy (a component of conventional municipal solid waste plant technology in commercial use); naturally flowing water and hydroelectric; low emission, advanced biomass power conversion technologies; storage and conversion technologies connected to qualifying generation projects; and fuel cells.

<sup>9</sup> Green buildings refer to designs that minimize environmental impacts.

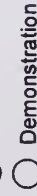
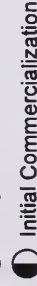
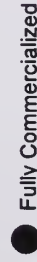
<sup>10</sup> For example, ocean thermal technologies are not well suited to this region of the country due to inadequate thermal gradients. Similarly, solar thermal and PV concentrators are not considered to have significant potential in the region because of relatively low direct insolation levels. Storage and conversion technologies are considered as part of energy systems.



**Table 1. Profile of Renewable Energy Technologies**

Energy Source	Description	Commercial Status	Primary Applications	Cogen Potential
Biomass	Biomass materials, including crop waste, forest residues, lumber and paper mill waste, and plants grown specifically for energy production, can be used to produce electricity. The most common approach is to burn biomass materials, creating heat than can be used to drive a steam-powered turbine and generator. However, recent years have seen the development of more efficient and cleaner technologies to convert biomass into gas and liquid fuels.	<input checked="" type="radio"/> waste-to-energy gasification & liquid fuels <input type="radio"/>	Central Distributed	✓
Fuel Cells	A fuel cell combines hydrogen-bearing fuel with air-borne oxygen in an electrochemical reaction to produce electricity, water and heat. The term "fuel cell" encompasses several technologies at different stages of maturity, each distinguished primarily by the type of electrolyte used and operating temperature.	<input checked="" type="radio"/> PAFC <input type="radio"/> PEMFC, MCFC, SOFC	Distributed	✓
Hydropower	The kinetic and potential energy of flowing water can be captured and turned into electrical energy. The most common type of hydropower plant uses a dam on a river to store water in a reservoir. Water released from the reservoir flows through a turbine, spinning it, which in turn activates a generator to produce electricity. Other hydropower systems, so-called run-of-the-river systems, do not use reservoirs.	<input checked="" type="radio"/>	Central	x
Landfill Gas	One by-product of the anaerobic decomposition of organic materials buried in landfills is methane – a flammable gas. This exhaust methane can be collected and subsequently used in a gas-powered turbine to produce electricity.	<input checked="" type="radio"/>	Central	✓
Ocean Thermal	Ocean thermal energy conversion (OTEC) systems produce power by utilizing the natural thermal gradient, or temperature variation, within the layers of the ocean. OTEC systems require a difference in temperature of at least 36 degrees Fahrenheit, and can be closed-cycle, open-cycle or a hybrid combination.	<input type="radio"/>	Central	x
Photovoltaic	Photovoltaic (PV) cells can convert sunlight directly into electricity. They are composed of silicon-based semiconductors, with small but functionally important quantities of other elements. PV systems usually contain many clusters of PV cells, called modules, plus wires, inverters, transformers and sometimes batteries.	<input checked="" type="radio"/> flat-plate <input type="radio"/> thin film	Distributed Remote	x
Solar Thermal	Solar thermal systems concentrate the sun's heat energy using reflective mirrors, troughs, dishes, and/or power-towers. The concentrated heat energy is then used to power conventional turbines to produce electricity. Solar thermal systems can also store thermal energy for later use.	<input type="radio"/>	Central	x
Wave/Tidal	Wave and tidal power systems utilize the kinetic energy present in waves and tides. Tidal systems accomplish this by utilizing dams to force water through turbines and thereby power generators. Wave power systems either channel waves into reservoirs (channel systems), or use waves to drive hydraulic pumps (float systems) or to compress air (oscillating water column systems), all of which produce electricity by either directly or indirectly driving generators.	<input type="radio"/>	Central	x
Wind Turbines	Wind turbines are machines that capture the wind's kinetic energy using propeller-like vanes attached to a central hub. The resulting rotational energy is converted into electrical energy using a generator.	<input checked="" type="radio"/> horizontal axis <input type="radio"/> vertical axis	Central Distributed Remote	x

Commercial Status:



Primary Applications:

Central

Distributed

Remote

Central Power Generation (on grid)

Distributed Power Generation (on grid)

Remote Power Generation (off grid)





## **2.2 The use of renewable energy technologies in central power generation has potential, but significant hurdles must be overcome in order to develop a sustainable, competitive green power market in the Commonwealth.**

### ***2.2.1 The generation of electricity from renewable energy sources needs to be considered within the context of the overall New England power grid.***

The New England power grid – 330 generating facilities connected by 7,000 miles of transmission lines – provides electricity to more than 6.2 million customers throughout the six-state region.<sup>11</sup> The grid links power plants in each of the six states (except for the northernmost part of Maine) and is directly tied to neighboring power grids serving New York, Quebec and New Brunswick. The current capacity of the New England power grid is on the order of 25,000 MW, consisting primarily of hydropower plants, coal-fired plants, oil-fired plants, gas-fired plants, and nuclear facilities.<sup>12</sup> Virtually all of the electric energy consumed in the region is generated at large power plants and delivered to consumers via the grid.

The power grid can be thought of as a huge reservoir. Discrete amounts of power from this reservoir are delivered to end-use customers via a network of high-voltage transmission lines and local distribution lines. Because of the physics of electricity, electric current flows on an instantaneous basis from whatever sources are on line at that moment to wherever demand is located on the grid. Therefore, a resident in Massachusetts can actually use electricity produced at a power plant in Maine or Quebec.

As illustrated in Figure 1, power generated from renewable resources flows into the grid along with power generated from power plants fueled by fossil and fissile fuels. According to a preliminary analysis conducted for the Division of Energy Resources (DOER), between 7 percent and 14 percent of the total energy (kWh) purchased by end-use customers in the Commonwealth were derived from renewable resources in 1997.<sup>13</sup> At least three-quarters of the renewable energy consumed in Massachusetts is produced through hydropower, the bulk of the remaining renewable energy is generated through waste-to-energy and landfill gas facilities.

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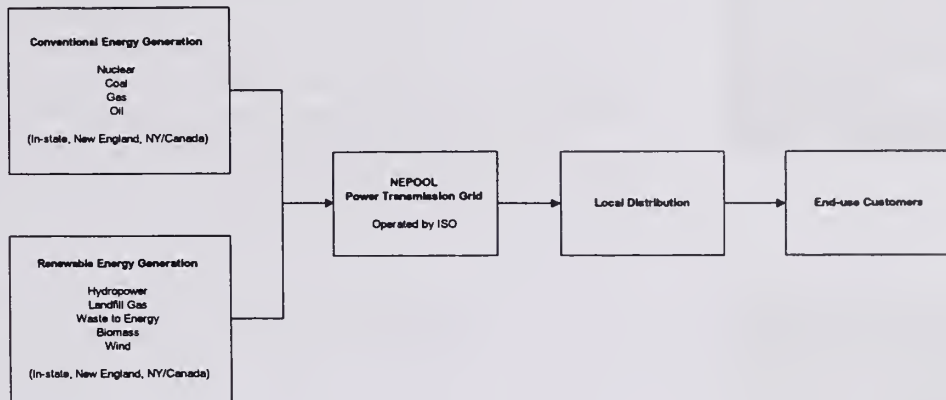
<sup>11</sup> The New England Power Pool (NEPOOL) was established in 1971 to direct the operations of the major generating and transmission facilities in the region. Following approval by the Federal Energy Regulatory Commission (FERC), ISO New England Inc. (ISO-NE) was established in July 1997 to manage the region's generation and transmission systems and administer the region's open access transmission tariff. Beginning in May 1999, ISO New England assumed responsibility of administering the restructured wholesale electricity marketplace for the region. ISO New England operates under a services contract with NEPOOL.

<sup>12</sup> Excluding imports from outside of New England.

<sup>13</sup> Smith, Douglas C., Cory, Karlynn and Grace, Robert C., "Massachusetts Renewables Portfolio Standard - White Paper #6: Sales From Existing Sources Calculation", October 25, 1999. The range reflects differences in how fixed energy contracts with Hydro Quebec are handled. Estimates of renewable energy consumption do not include system power contracts with undefined renewable content.



**Figure 1. Conventional and Renewable Energy in the New England Power Grid**



According to data maintained by the National Renewable Energy Laboratory (NREL), the total grid-connected generating capacity from *renewable resources* in Massachusetts is on the order of 2000 MW, with hydro representing fully 87 percent of the total existing capacity as shown in Table 2.<sup>14</sup> The existing wind and photovoltaic facilities were established as demonstration projects by local utilities and businesses. These include eight wind turbines with a total capacity of 340 kW installed by the Princeton Light Department in 1984, approximately 85 kW of PV rooftop capacity developed by the Massachusetts Electric Company in Gardner in 1986, 100 kW of PV installed at the Beverly High School as part of President Carter's Photovoltaic Demonstration Project in 1981, 37 kW of PV installed on the roof of the J.F. Williams Coast Guard facility in downtown Boston, 20 kW of PV installed at the Porter Square Shopping Center in Cambridge, and 12 kW of PV installed at the BJ's Wholesale Club in North Dartmouth.

**Table 2. Capacity of Existing Renewable Energy Generating Facilities in Massachusetts**

	Hydroelectric	Bioenergy	Wind	Photovoltaics	Total
<b>Capacity</b>	1,733,235 kW	244,380 kW	360 kW	301 kW	1,978,276 kW

Source: REPIS, National Renewable Energy Laboratory. Bioenergy includes waste-to-energy, landfill gas and other biomass generating plants.

Additional wind projects have been developed in other parts of New England – the largest of these is located in Vermont with a total capacity of approximately six megawatts. Owned by Green Mountain Power, the wind farm consists of eleven 550 kW wind turbines. The U.S. Department of Energy and the Electric Power Research Institute contributed \$3.9 million toward the \$11 million project. The wind plant has been in operation since June 1997.

<sup>14</sup> The table is limited to facilities that are connected to the grid and used in central power generation.





### **Porter Square Shopping Center**

Location: Cambridge, Massachusetts  
Energy Type: Photovoltaic  
Generating Capacity: 20 kW  
Installation Date: September 1999

Porter Square's photovoltaic system was installed as part of a general remodeling of the shopping center, owned by Gravestor, a real estate firm. The system was designed and installed by Applied Power Corporation and is made up of photovoltaic modules produced by ASE Americas, Inc. of Billerica, Massachusetts.



### **Princeton Municipal Light Wind Farm**

Location: Wachusett Mountain, Central Massachusetts  
Energy Type: Wind Turbine  
Generating Capacity: 330 kW  
Installation Date: 1984

The oldest windpower plant in Massachusetts, Princeton Municipal Light's wind farm originally consisted of eight turbines rated at 40 kilowatts each, producing a total of approximately 180,000 kwh per year\*. In 1999, the utility received a \$51,000 grant from the U.S. Department of Energy to upgrade one of its turbines to 50 kilowatts.

\*Source: The American Wind Energy Association, 1998



### **Beverly High School**

Location: Beverly, Massachusetts  
Energy Type: Photovoltaic  
Generating Capacity: 100 kW  
Installation Date: 1981  
Cost: \$3 million\*

Beverly High School was one of eight sites across the United States chosen for photovoltaic installations as part of President Carter's Photovoltaic Demonstration Project in 1980. Today it is the only remaining functional site of the original eight - the others fell into disrepair due to lack of funding for continued operation and were subsequently scrapped or sold. The Beverly array provides an estimated \$8,000-\$10,000 of energy to the town of Beverly per year and is also used for classroom education.

\* includes cost of array, visitor's center and data gathering equipment



### **US Coast Guard Facility**

Location: Boston, Massachusetts  
Energy Type: Photovoltaic  
Generating Capacity: 37 kW  
Installation Date: 1999

The US Coast Guard installed this PV system atop the roof of its facility in the John F. Williams Building in downtown Boston. It contains 372 photovoltaic roof tiles manufactured by the Powerlight Corporation, and is the largest building-integrated PV installation in New England, providing enough electricity to power two floors of the building during daylight hours. In addition, the integrated solar tiles insulate the building, reducing the cost of heating and air-conditioning while doubling the life expectancy of the roof.

The General Services Administration bought the array for the US Coast Guard from Enron Energy Services Operations, Inc. Funding for the system was provided in part by the National Renewable Energy Lab and the Utility PhotoVoltaic Group's TEAM-UP program, which provides cost-sharing from the US Department of Energy for innovative solar business ventures.



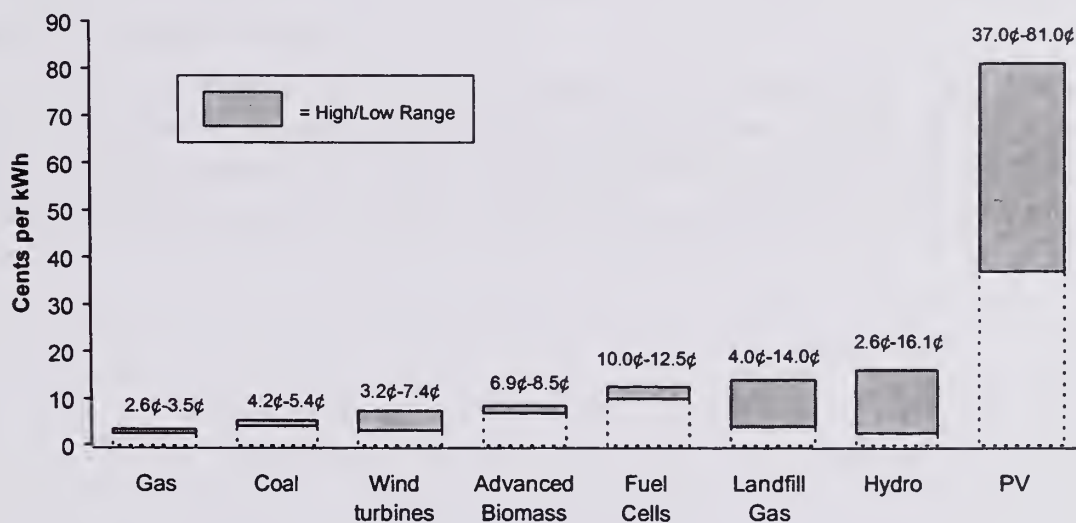




### 2.2.2 The primary barrier to increased use of renewable energy technologies for central power generation has been its relatively high cost.

Energy generated from renewable resources tends to cost significantly more than energy produced by burning gas or coal as illustrated in Figure 2, driven primarily by relatively higher capital costs and lower electric efficiency.<sup>15</sup> For example, the total cost of energy generated at new gas-fired power plants is on the order of three cents per kWh, including construction and ongoing operations. In comparison, it costs anywhere from 37 cents to 81 cents per kWh to generate electricity using photovoltaic technologies. Put another way, electricity generated with current photovoltaic technologies is 10 to 20 times more expensive than electricity generated using the most efficient gas turbines. As such, it is not generally perceived to be competitive economically for use in central power generation.<sup>16</sup>

Figure 2. Levelized Cost of Energy



Source: Department of Energy Office Utility Technologies; Electric Power Research Institute, 1997 and Arthur D. Little, Inc.

<sup>15</sup> Levelized cost refers to the present value of the total cost per kWh of generating electricity over the life of the facility, including capital, fuel, and operating and maintenance costs. The cost ranges presented in the graph are based on different assumptions with respect to efficiency, financing terms and tax incentives. In general, the low end of the range assumes that projects are located in favorable sites, backed by significant equity investments, and qualify for available federal and state tax incentives. Assumptions are described in detail in Appendix C.

<sup>16</sup> The costs of renewable power generation is likely to decline, but the volume required to bring renewable energy to cost parity with fossil fuel technologies is likely to be significant particularly with respect to photovoltaics. For example, a study prepared by KPMG concluded that the scale of production needed to drive the cost down to 10 to 13 cents per kWh would be on the order of 500 MW per year in a *single* facility. This is roughly three times total world capacity. See "Solar Energy: From Perennial Promise to Competitive Alternative," KPMG, August 1999.



On the other hand, wind turbines are capable of generating power at a cost near that of conventional sources depending on wind conditions, federal tax incentives and other factors.<sup>17</sup> The cost of electricity from wind has dropped from 35 cents per kWh in 1980 to less than five cents per kWh today at wind sites with favorable conditions, i.e., sites with average wind speeds of at least 15 mph.<sup>18</sup>

With the exception of hydropower, which has been developed extensively in the region, the relatively high cost of renewable energy has hindered the development of major renewable energy generating facilities for grid power in Massachusetts as well as in the rest of the United States. In general, the renewable generating capacity that has been installed by utilities has been supported by generous government subsidies and by regulatory authorities, which have allowed utilities to pass on higher costs to consumers.

### ***2.2.3 Wind offers the greatest potential for large-scale generation and efforts have already begun to develop resources in the region.***

There is significant existing hydroelectric generating capacity in New England as well as potential imports to meet potential demand for renewable energy in Massachusetts.<sup>19</sup> However, any significant new, non-hydro generating capacity in New England is likely to center on wind based on its comparatively low cost.

Table 3 provides a list of six wind projects that are in various stages of planning in New England. Together, these projects have a total capacity of over 160 MW. Not all of these planned projects are likely to go forward. These and other projects may face significant technical constraints as well as hurdles in winning local approval and securing financing.

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<sup>17</sup> The federal government provides a production tax credit of 1.5 cents per kWh to encourage construction of new wind generating facilities. The credit was recently extended through December 31, 2001.

<sup>18</sup> The single most important variable governing performance is average wind speed. The power in wind is proportional to the cube of the wind speed. Therefore, all else equal, wind turbines on a site with average wind speeds of 16 mph are capable of generating 137 percent more energy than those located on a site with average speeds of 12 mph.

<sup>19</sup> Massachusetts Renewables Portfolio Standard, White Paper #4: Treatment of Existing Renewable Resources December 3, 1999, Prepared by: Robert C. Grace Sustainable Energy Advantage, LLC and Brent M. Haddad, Ph.D. University of California, Santa Cruz under contract to Sustainable Energy Advantage, LLC. According to the report, ignoring imports, the estimated annual production from existing RPS-eligible renewable resources is approximately 14,900 GWh per year, or 11.4 percent of the electrical load in New England in 2003. If imports are considered as eligible, the available supply of existing renewables eligible for RPS requirements in New England could exceed 29,000 GWh, or over 22.3 percent of New England's electrical load. Depending on how imports are handled, after satisfying Maine and Connecticut RPS requirements, the supply of Massachusetts-RPS-eligible resources could be almost three times the Massachusetts baseline fraction of renewable energy purchases.





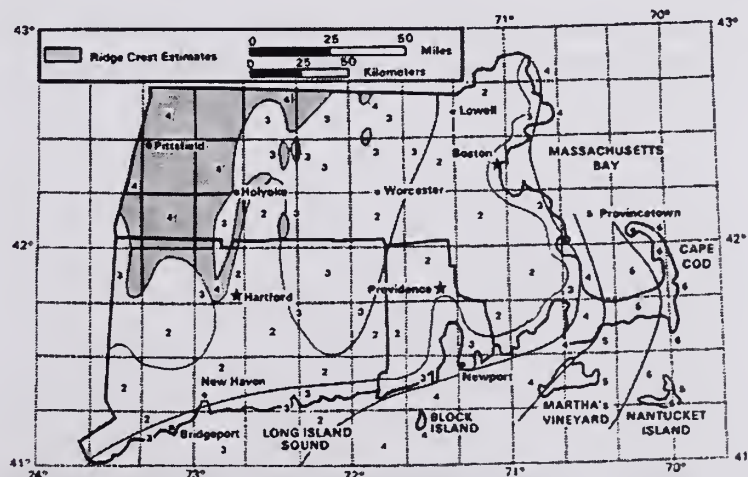
**Table 3. New England Wind Projects in Various Stages of Planning**

State	Developer	Generating Co.	Plant Name	Capacity (MW)	Landmark/City
MA	NA	NA	Brodie Mountain	25.2	Brodie Mountain/Hancock
MA	Ocean Energy Systems, LLC	NA	NA	100.0	Nantucket Sound
ME	Endless Energy	Merchant	Reddington Pond	20.0	Reddington Mountain
ME	Enron Wind Corp.	NA	Boundary Mountains	6.0	Franklin/Somerset
RI	Endless Energy	NA	Rhode Island Energy Collaborative	2.0	NA
VT	Endless Energy	Central VT Public Service Corp.	Little Equinox	4.6	Manchester

Source: REPIS, National Renewable Energy Laboratory and interviews.

As far as potential sites in Massachusetts are concerned, the best wind resources in Massachusetts can be found on Cape Cod and the Islands as demonstrated in Figure 3. The Department of Energy (DOE) has determined that these outer coastal areas have the highest wind energy potential (class 5 and 6 winds) in southern New England. Limited two-year data from Nantucket Island and Provincetown established that these areas have class 6 (14.3-15.7 MPH winds) or better annual average wind power at 50 m (164 ft). However, any future projects would need to overcome community and environmental concerns over siting, as well as significant financial constraints, in order for the potential of wind to be realized.

**Figure 3. Wind Resources in Southern New England**



Source: Department of Energy



While it has been very difficult to site large facilities in New England, it should be noted that one of the largest wind farms in the world is being developed in Quebec along the Gaspé Peninsula. With an average wind velocity of roughly 17 miles per hour, the area is one of the most suitable wind sites in Canada. Under construction since May 1998, the 133-turbine 100 MW wind farm is being developed under an agreement signed between the developers and Hydro-Québec. Under the agreement, Hydro-Québec will purchase all electric power generated by the wind farm for a minimum of 25 years for approximately 3.8 cents per kWh.

The total investment for the project is \$110 million. The lead developers – AXOR and M&N Wind Power – invested \$30 million. In addition, the Mutual Group (Canada) put together debt financing of \$75 million involving a group of Canadian lenders. The Quebec government, through the Société de Développement Industriel du Québec (SDI) also provided a \$3.8 million grant for manufacturing the towers and assembling the wind turbines in Quebec.

There are plans to expand the generating capacity significantly in the years to come. The provincial government in Quebec recently announced its support for a plan that could see a system of wind farms generating 450 MW of power by the year 2011. The plan calls for the construction of 60 to 70 wind turbines each year. Hydro-Quebec would buy the output of the wind farms and resell it to its wholesale customers.

Ground has also been broken for a seven turbine, 11.5MW wind project – Madison Windpower – in upstate New York. The project will provide approximately 24 million kWh per year to the Northeast power grid through the New York State Electric & Gas transmission system and the New York Independent System Operator (ISO). Slated to be operational by fall 2000, the wind farm is estimated to cost somewhere in the neighborhood of \$15 million upon completion. The New York State Energy Research and Development Authority (NYSERDA) has agreed to cover \$2 million of this under a cost-sharing agreement with The National Energy Group, a division of PG&E Corporation and owner and developer of the project.

At a minimum, these two examples may provide lessons on factors that are critical to the success of wind projects – lessons that might be applied to potential projects in Massachusetts and other parts of New England. In addition, it raises the possibility that customers in Massachusetts may be able to access new wind resources, albeit outside of the ISO-NE region.<sup>20</sup>

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<sup>20</sup> Transmission constraints from northern New England and New York may limit the flow of electricity from wind resources to Massachusetts. Wind Energy in the Northeastern U.S. - Leverage Points for Growth, Energy & Environmental Ventures LLC, April 21, 2000

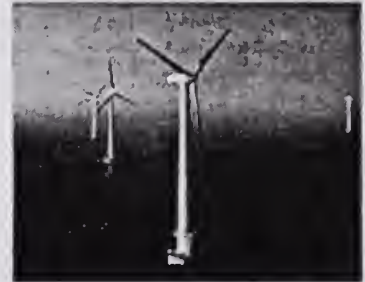


## Offshore Wind Power in Denmark

For countries with high population densities and siting difficulties, offshore wind power is becoming an increasingly attractive alternative. One such country, Denmark, has announced plans to install up to 4,000 MW of offshore wind power by the year 2030 - enough electricity to supply forty percent of the country's current demand.

Denmark already has two near-shore wind farms operating in water depths averaging 2.5 to 7.5 meters. Vindeby, Denmark's first windfarm, consists of eleven 450kW turbines located in the Baltic Sea 1.5 and 3 kilometers from the coast. Turbines for this project were modified for the marine environment by internalizing high voltage transformers and raising tower entrance doors. Tunø Knob, Denmark's second wind farm, was built four years later and 3 additional kilometers from the mainland. Its ten 500kW turbines were further modified to incorporate knowledge gained in the Vindeby project. For example, gearboxes were modified to allow for the higher rotational speeds permitted by the remote location of the wind farm. Each turbine was also equipped with a small crane to allow for the replacement of major parts without the need for expensive floating cranes.

According to the Danish Wind Turbine Manufacturing Association, new developments in steel foundations and megawatt-sized wind turbines are close to making shallow (15 meters or less) offshore wind energy competitive with onshore sites given that offshore turbines generally yield 50% higher output than their land-based counterparts.



### ***2.2.4 While energy generated from renewable sources is likely to cost more than conventional energy, numerous studies suggest that consumers are willing to pay more for renewable energy.***

Numerous studies conducted over the past few decades have shown that people in the United States would prefer energy produced from renewable resources. Perhaps more importantly – at least from the perspective of those interested in promoting renewable energy in competitive markets – various studies have also suggested that some customers would be willing to pay at least a modest amount more per month on their electric bills for power from renewable resources.<sup>21,22</sup>

The National Renewable Energy Laboratory (NREL) recently issued a report that analyzed the results of 14 different surveys of residential customers conducted by electric utilities in several different states.<sup>23</sup> The results from all of these surveys are consistent as illustrated in Figure 4. Collectively, they suggest that approximately 70 percent of residential customers would pay up to \$5 per month more for electricity from renewable resources. Some 20 percent indicate that they are willing to pay up to \$15 per month more for renewable energy.

<sup>21</sup> Some of these studies also indicate that customers would rather see higher costs for renewable energy incorporated into the rate base, rather than charged as a premium on individual bills.

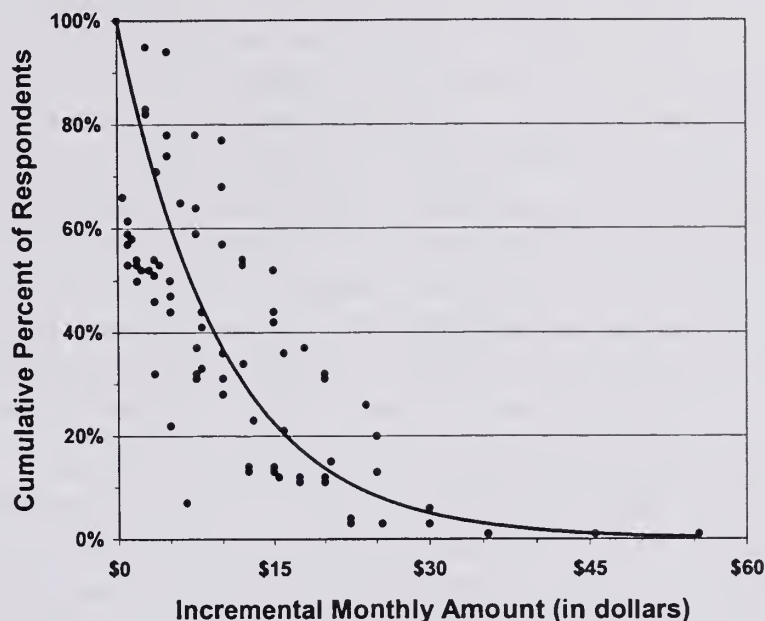
<sup>22</sup> Preliminary evidence from other states indicates that some commercial, industrial, public and non-profit institutions are also interested in purchasing green power.

<sup>23</sup> Farrar, Barbara C., *Willingness to Pay for Electricity from Renewable Resources: A Review of Utility Market Research*, National Renewable Energy Laboratory, July 1999.





**Figure 4. Willingness of Residential Customers to Pay for Renewable Energy**



Source: Farhar, Barbara C., *Willingness to Pay for Electricity from Renewable Resources: A Review of Utility Market Research*, National Renewable Energy Laboratory, July 1999.

To put this in perspective, the average monthly residential bill in Massachusetts is approximately \$55 for 600 kWh. A willingness-to-pay \$15 more per month is equivalent to a total price premium of 27 percent or roughly 2.5 cents per kWh.<sup>24</sup> Based on this survey data, the price premium that some customers indicate a willingness to pay may be sufficient to cover the additional costs of generating power from renewable resources such as wind.<sup>25</sup> If this demand were to materialize among 20 percent of residential consumers in Massachusetts, it would represent an annual market of approximately \$75 million.

Although these surveys are useful in helping gauge the potential market for renewable energy, actual evidence on the number of people who willingly pay more for green power in competitive markets is limited. As explained further below, the experience in California offers little guidance on the sustainability of green power markets due largely to approved rates for consumers that continue to purchase electricity from their existing suppliers. The results in Pennsylvania are

<sup>24</sup> The 27 percent price premium is based on the total price paid by residential consumers, including charges for generation, transmission, distribution, transition and other surcharges.

<sup>25</sup> As noted above, the levelized cost of wind is on the order of 0.6 to 4.8 cents per kWh higher than energy produced by the most efficient gas-fired power plants. (This excludes customer acquisitions costs and additional administration costs related to settlements and disclosure). Therefore, a 2.5 cents price premium may be sufficient to cover the additional costs of wind energy depending on the particular characteristics of the project.



more positive, demonstrating that some consumers are willing to pay a modest amount more for energy generated with renewable resources.

- **California.** Over 250 companies registered as retail energy service providers (ESPs) when electricity markets were opened to competition in California in April 1998. Just one year later, fewer than ten ESPs remained active in the market and only six were offering green power. While the direct access market has grown steadily, only 162,000 residential and small commercial customers had switched providers as of September 1999, representing less than 2.5 percent of the total utility load for this segment of the market. However, approximately 85 percent of these customers were being provided with green power – the bulk of which came from existing resources.<sup>26</sup> While regulations have hampered the development of conventional energy markets, available state incentives have promoted the growth of the green power market. The State of California's Renewable Customer Credit of 1.5 cents per kWh allows green power to be sold *below* the default rate, making green power the only discounted power option available to small customers in California.
- **Pennsylvania.** In contrast, the experience in Pennsylvania suggests that there may be a sustainable market for green power. Retail competition began in Pennsylvania on January 1, 1999. In contrast to California, the market for electricity has developed fairly quickly, spurred by market energy prices that are significantly lower than the regulated default rate in most service territories.<sup>27</sup> As a result, more than 500,000 customers switched from their default utility service to an alternative supplier as of January 1, 2000, representing roughly 10 percent of all customers and 29 percent of total consumption. The Pennsylvania Office of Consumer Advocates (OCA) estimates that up to 71,000 customers may be purchasing renewable energy products from energy suppliers in the state. Interviews with representatives of GreenMountain.com suggest that the company has on the order of 60,000 customers in Pennsylvania. A significant percentage of these customers have purchased a one percent renewable energy product; the remaining customers are split between the company's 50 percent and 100 percent renewable energy products. The Energy Cooperative Association of Pennsylvania (ECAP) offers a 100 percent renewable energy product consisting of 80 percent biomass and 20 percent small hydroelectric energy.<sup>28</sup> The price of the Eco-Choice 100 product has been set at 5.65 cents per kWh to meet the default power price in the service area. ECAP also continues to offer a traditional non-renewable energy option at a price of 4.79 cents per kWh. Approximately 10 percent of the company's 8,000 customers have signed up for the Eco-Choice 100 plan. Of the 800 Eco-Choice 100 customers, approximately 770 are residential. Table 4 compares the

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<sup>26</sup> Enron Wind Corp., a subsidiary of Enron Corp., began producing power at its Green Power I Wind Power facility near Palm Springs, CA in June 1999. The 22-turbine, 16.5-megawatt project was the first major renewable power plant to go online since California opened its markets to competition in 1998. Since then additional wind and geothermal resources have been developed. The delay in the construction of new facilities is not unexpected. Developers are waiting to see how the market evolves. Moreover, it takes a minimum of 12 to 18 months to go through the design, permitting, financing and construction process.

<sup>27</sup> The difference between the market rate and the regulated default rate is sometimes referred to as a "shopping credit." This is a misnomer. Unlike in California, the state does not offer actual financial credits to either consumers or energy producers.

<sup>28</sup> ECAP recently discontinued a product based on 50 percent renewables.





default rate to the prices of alternative products offered by Green Mountain and ECAP.<sup>29</sup> The 50% and 100% renewable energy products offered by these two companies have been certified under the Green-e program.<sup>30</sup>

**Table 4. Pricing Schedules for GreenMountain.com and ECAP  
Compared to Default Rate (Cents per kWh)**

	<b>Default Rate</b>	<b>Competitive Conventional</b>	<b>1% Renewable</b>	<b>50% Renewable</b>	<b>100% Renewable</b>
<b>Green Mountain</b>	5.65	NA	5.52	6.46	7.09
<b>ECAP</b>	5.65	4.79	NA	NA	5.65

Source: Company interviews

<sup>29</sup> Prices actually vary by service area. The rates presented in the text were established for the PECO service territory. Beginning June 1, 2000, Green Mountain will be charging a \$5.95 monthly fee in addition to rates listed above.

<sup>30</sup> The Green-e Renewable Electricity Certification Program was established by the Center for Resource Solutions, a non-profit organization based in California. Accurate and credible data regarding the mix of energy sources used in green power products is essential to efficient markets.



## Energy Cooperative Association of Pennsylvania

The Energy Cooperative Association of Pennsylvania (ECAP) is the only non-profit consumer cooperative licensed to supply electricity in Pennsylvania.



ECAP offers fuel oil and electricity to both residential and commercial members. The cooperative also provides energy conservation and efficiency services, consumer education services and materials, energy audits, and solar hot water heating and electricity systems.

The cooperative's electricity offerings include both standard and renewable energy options. The renewable electricity offering is a 100 percent renewable energy product certified by the Green-e Renewable Electricity Certification Program.

ECAP charges an annual fee of five dollars for residential members and twenty-five dollars for commercial members. These annual fees are waived for senior citizens, low-income persons and persons with disabilities. Members may leave the cooperative at any time without penalty by providing 30 days notice.

Currently, ECAP provides electricity in the PECO (Pennsylvania Electric Company) service territory, and is able to provide 100 percent renewable electricity at rates equal to PECO's rates for standard, non-renewable electricity. In the PECO service area, ECAP's residential rates are 4.79 cents per kWh for standard electricity and 5.65 cents for Green-e certified 100 percent renewable electricity. For residential heating, ECAP's rates are 4.54 cents per kWh for standard heating and 5.25 cents for Green-e certified 100 percent renewable heating. ECAP guarantees rates until January 2001 for standard offerings and for one year from sign-up for renewable energy offerings.

## Green-e Renewable Electricity Certification Program

The Green-e Renewable Electricity Certification Program was established by the Center for Resource Solutions, a non-profit agency based in California. Green-e is the first and only voluntary program in the United States for certifying "green" electricity offerings. Electricity offerings meeting the program's standards are eligible to carry the Green-e logo.



The program was launched in California in 1997, shortly before California's electricity market was opened to competition. It has since been expanded to Pennsylvania, New England and New Jersey. Over 250,000 customers currently purchase Green-e certified electricity in these areas.

There are currently 16 green-e certified retail electricity offerings originating from ten different companies. In order for an electricity offering to be Green-e certified, at least 50 percent of the electricity must come from renewable energy sources, including solar, wind, biomass, geothermal and small-hydroelectric. In addition, any non-renewable sources must produce less air pollution (lower emissions of SO<sub>2</sub>, NO<sub>x</sub>, and CO<sub>2</sub>) than the traditional electric offering in the area, and none of the electricity can come from nuclear power. Green-e certified renewable energy also must contain at least five percent new renewable energy one year after deregulation and ten percent after two years. Green-e intends to increase this figure by five percent each year until it reaches 25 percent.

In addition, Green-e requires certified firms to disclose their energy sources and submit to an annual third-party audit to ensure that they purchase enough renewable energy to cover their sales. In addition, certified firms' Green-e product marketing materials are reviewed biannually to ensure accuracy.



There is more experience in green pricing among regulated utilities than in unregulated competitive markets. To date, more than 50 utilities have either implemented or announced plans to offer a green pricing option under which participating customers pay a premium on their electric bill to cover the extra cost of the renewable energy. Table 5 presents information on some of the more successful programs that have been established in the United States. These programs do demonstrate that some customers are willing to pay more for energy generated from renewable resources. In the case of Austin Energy the premium is very modest – 0.4 cents per kWh. Other utilities charge a higher premium for renewable energy. For example, the 1,900 customers who are participating in the Solar Choice program offered by the Salt River Project in Arizona pay \$3.00 per month for the equivalent of 15 kWh – a premium of 20 cents per kWh.

**Table 5. Selected Utility Green Pricing Programs**

Utility	Austin Energy (TX)	LA Dept. of Power and Water (CA)	Madison Electric & Gas (WI)	Salt River Project (AZ)
<b>Program</b>	Green Choice	Green Power for Green LA	Wind Power Program	Solar Choice
<b>Est.</b>	2000	1999	1997	1998
<b>Type</b>	Wind and landfill gas	Geothermal, biomass, Wind	Wind	Central PV
<b>Capacity</b>	40 MW by Fall 2000	Using 20 MW	8.25 MW	200 kW
<b>Premium</b>	\$0.004 per kWh	\$0.03 per kWh	\$0.033 per kWh	\$3 per month for 100 watts or (15 kWh)
<b>Customers</b>	700 residential customers 5 commercial customers	30,000 customers, (50% residential)	5,000 customers	1,900 residential customers.
<b>Market penetration</b>	Program is 15% subscribed  0.2% of customer base participating	Open subscription  2.3% of customer base participating	Fully subscribed  4.6% of customer base participating	Fully subscribed  2.7% of customer base participating

Source: National Renewable Energy Laboratory and utility interviews

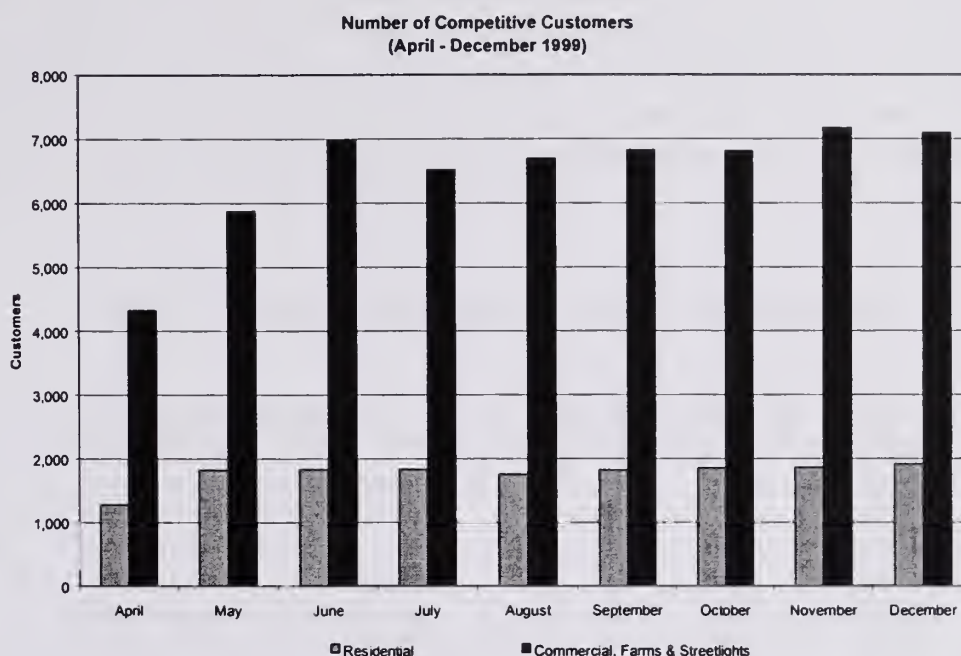
### ***2.2.5 While restructuring makes choice possible, the vast majority of customers have elected to stay with the standard and default service offer in Massachusetts.***

Approximately 9,000 customers have switched to competitive suppliers in Massachusetts, representing less than 0.4 percent of the total customer base and 9.3 percent of total kWh purchased by end-customers. Led by large industrial consumers, the bulk of these customers moved to a new service in the initial two to three months after the legislation went into effect as illustrated in Figure 5. Most of these customers were part of large aggregations such as Massachusetts Health and Educational Facilities Authority (HEFA), Massachusetts High Technology Council (MHTC) and Associated Industries of Massachusetts (AIM) that were able to negotiate favorable prices directly with power suppliers.





**Figure 5. Growth in Competitive Market for Electricity in the Commonwealth**



The competitive market in Massachusetts has been slow to develop primarily because of the manner in which the standard offer service was structured in the enabling legislation. To ensure that consumers would benefit during the transition to fully competitive markets, the Act required all electric distribution companies to provide a “standard service transition rate” to their customers. It further guaranteed that customers that continue to purchase electricity from their current supplier would receive a 15 percent reduction in their electric rates over a two-year period.<sup>31</sup>

When the Restructuring Act went into effect, the standard-offer rate was set at 2.8 cents per kWh. The rate remained at this level throughout 1998 with two exceptions: Boston Edison and Massachusetts Electric increased their standard-offer rate to 3.2 cents in June and September, respectively, following the sales of their non-nuclear power plants. In 1999, the approved rates varied from 3.1 cents to slightly over 3.7 cents in different service territories in the Commonwealth. In comparison, the weighted average spot price for electricity was 3.54 cents per kWh between May 1999 and March 2000, ranging from a peak of 5.96 cents per kWh last June to a low of 2.57 cents per kWh in December.<sup>32</sup> As a result, during the first 21 months in which markets were open to competition, the standard offer rates in most service areas were at

<sup>31</sup> Specifically, the Act mandated a 10 percent rate reduction as of March 1, 1998, and an additional five percent reduction as of September 1, 1999. The rate reduction was based on prevailing rates in 1997 after adjusting for inflation. By default, the “standard offer” will continue to be offered to a customer until that customer chooses a new supplier. The “standard offer” does not apply to MLP customers.

<sup>32</sup> The weighted average is based on monthly electricity loads during the period. The spot price is a proxy for wholesale prices in the market. Actual contracts may be lower than the spot price.



or below the wholesale price for electricity making it extremely difficult for new power suppliers to compete effectively for customers.

As shown in Table 6, the highest standard offer among the seven distribution companies was 3.7 cents during 1999. Even in this area, the 0.2 cents difference between the standard offer and the average wholesale price has been described as insufficient to cover customer acquisition and other startup costs that competitive power suppliers would have had to incur to be active in the market. Interviews with industry representatives suggest that customer acquisition costs alone run about 1.5 cents per kWh.

**Table 6. Approved Standard Offer Rates (cents per kWh)**

<b>Distribution company</b>	<b>1999</b>	<b>2000</b>
<b>Boston Edison Co.</b>	3.690	4.500
<b>Cambridge Electric Light Co.</b>	3.500	3.800
<b>Commonwealth Electric Co.</b>	3.500	3.800
<b>Eastern Edison Co.</b>	3.100	3.800
<b>Fitchburg Gas and Electric Co.</b>	3.100	3.800
<b>Massachusetts Electric Co.</b>	3.707	3.800
<b>Western Massachusetts Electric Co.</b>	3.100	4.557

As noted above, given the higher cost of renewable energy, the price differential was even greater for green power suppliers. Even with blended products, green power suppliers faced significant hurdles in introducing a competitive product into the market in 1999. In fact, most green power suppliers decided not to enter the market in Massachusetts, choosing to concentrate on California and Pennsylvania. As of May 2000, only AllEnergy was marketing green power in Massachusetts.<sup>33</sup>

Nevertheless, market conditions in Massachusetts will become more favorable to competition as the standard offer rate increases over time. The approved standard offer rates for 2000 for Boston Edison and Western Massachusetts Electric are already 4.5 cents and 4.557 cents, respectively. The other five distribution companies have established the rate at 3.8 cents per kWh. To comply with state regulations, standard offer rates are required to increase to at least 4.2 cents by 2002, 4.7 cents by 2003, and 5.1 cents by 2004.<sup>34</sup>

<sup>33</sup> AllEnergy's product, ReGen, is a premium service and does not substitute for or replace any part of customers' base electricity charges. Customers pay \$96 to support the generation of 2,000 kWh per year from new renewable energy capacity in New England. Customers can support additional 2,000 kWh blocks of new renewable energy capacity for \$72 each per year. The company currently has approximately 300 ReGen customers.

<sup>34</sup> Connecticut recently approved standard offer rates between 5 and 5.5 cents per kWh. While this makes the state a more attractive market for competitive suppliers than Massachusetts, it may also promote the development of the market in the Commonwealth as power suppliers take advantage of crossover media markets and potential economies of scale.





As the overall competitive market heats up, however, the green power market may still be constrained by regulations, limited consumer awareness and other factors.

- **Settlement and disclosure.** Settlement and disclosure rules refer to the frequency with which generators will be required to prove and disclose the amount of energy they have actually contributed to the power grid. The frequency of required energy settlement could have a material impact on the scale of operations required of green power generation facilities, and thus the overall economics of those generation facilities. If, for instance, settlement is required on a daily basis, green power generators would be required to contribute their daily quota of electricity to the grid every day, rather than achieving the quota over an extended period of time. Given the intermittent nature of many renewable energy sources in New England (such as wind or sunlight), this could force a power merchant to incur enormous expenses to ensure that it supplied power in the exact proportions it claimed in its advertising and disclosure labels. Yearly settlement, on the other hand, would accommodate the inherent unpredictability of renewable energy sources. Generators need to reflect the hourly or daily fluctuations in energy generated by renewable resources to meet load obligations. Most states, such as California, Maine, New Jersey and New York have established yearly settlement rules.
- **Renewable Portfolio Standard.** Another variable affecting the development of renewable energy in Massachusetts is the renewable portfolio standard (RPS) enacted as part of the Restructuring Act. The RPS requires that electricity suppliers provide retail customers with minimum levels of electricity generated from "new" renewable energy sources according to a schedule defined in the legislation, beginning at 1.0 percent of sales in 2003 to 4.0 percent in 2009. The legislation leaves room for the DOER to promulgate rules that include hydropower or other technologies within the defined set of new renewable generation technologies. Moreover, other states such as Maine and Connecticut have enacted RPS legislation with different levels and categories of renewable power that meet their legislative directives.
- **Consumer awareness.** Various studies have demonstrated that consumers are fairly uninformed about how the energy system operates with little understanding of where and how energy is generated and distributed. For example, in its annual report card on Americans' environmental knowledge, the National Environmental Education and Training Foundation revealed that a large majority of Americans do not know that electricity generation contributes to air pollution.<sup>35</sup> They believe that most electricity comes from hydroelectric dams and solar energy rather than burning fossil fuels. It is reasonable to expect then that, absent an effective consumer awareness campaign, consumers may balk at paying a premium for a product they think they are receiving already.

The green power market could also present consumers with a vast array of choices based on the type of generation technology employed, new versus "repackaged" energy sources, the location of the generation source, different "blends" of green and conventional power,

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<sup>35</sup> 1998 *National Report Card on Environmental Knowledge, Attitudes and Behaviors*, National Environmental Education and Training Foundation, 1998.



combinations of electricity and other consumer products, each with a different cost (and benefit) attached. The very complexity of the choice may be an impediment to the development of the market. Consumers may be reluctant to pay more for green power, absent information from a credible source that their expenditure is a prudent one.

#### **2.2.6 *Combined cycle gas turbines may reduce the ability of energy suppliers to differentiate their products based on environmental benefits.***

The restructuring of the electric utility industry in Massachusetts and New England is leading to the rationalization of existing generating capacity and construction of new power plants to meet demand in the region. Perhaps most importantly, competition has sparked interest among major developers in building new merchant power plant capacity in New England. New England is particularly attractive to developers given the existing fleet of aging, high-cost fossil-fuel plants and nuclear plants that are slated for decommissioning.

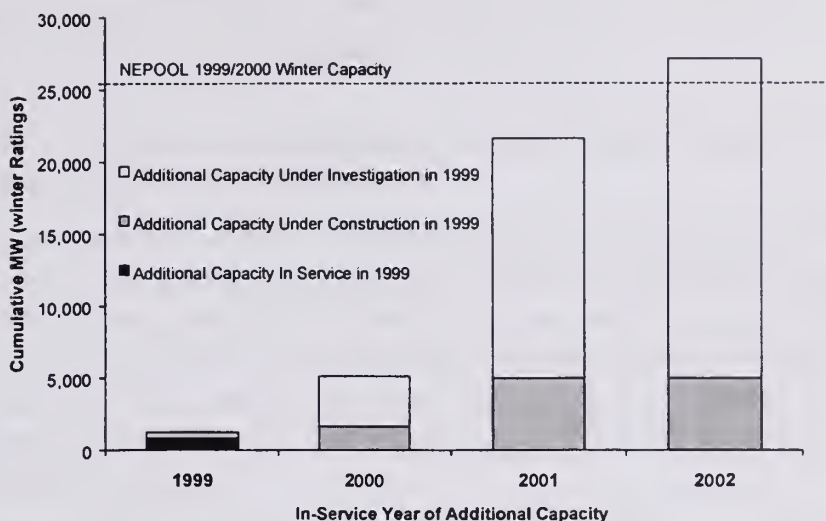
Figure 6 shows the additional capacity that has been proposed in the region along with the development status as of October 1999.<sup>36</sup> Significantly, gas-fired combined cycle gas turbines (CCGT) account for at least two-thirds of the proposed capacity. On a levelized cost basis, energy produced by CCGT ranges between 2.7 cents and 3.4 cents per kWh. To get a true picture of the cost competitiveness of gas, the all-in cost of gas is typically compared to the ongoing operating costs of existing facilities on the assumption that their capital costs have already been fully amortized. Even on this basis, electricity generated with CCGT is less expensive than nuclear power plants, oil-fired power plants, and some coal-fired power plants.

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<sup>36</sup> Gas pipeline capacity is sufficient to meet the likely demand from these new facilities. Existing pipelines can support additional summer peaking generation or year-round generation with dual fuel (gas/oil) capacity. The New England Natural Gas Transmission System brings gas from Western Canada and other supply basins to New England via the TransCanada Pipeline with a capacity of 210,000 Mcf/day by 2000. Capacity could be more than tripled through the addition of compressors. The Maritime and Northeast Pipeline brings gas from Sable Island (off Nova Scotia) with a capacity of 400,000 Mcf/day by 2000. Capacity could be expanded by 50 percent with the addition of compressors. The New England Gas Association recently calculated that these two new pipelines, combined with the Cabot (LNG) terminal expansion, could support 10,000 MW of new, base-load gas-fired plants in the region.

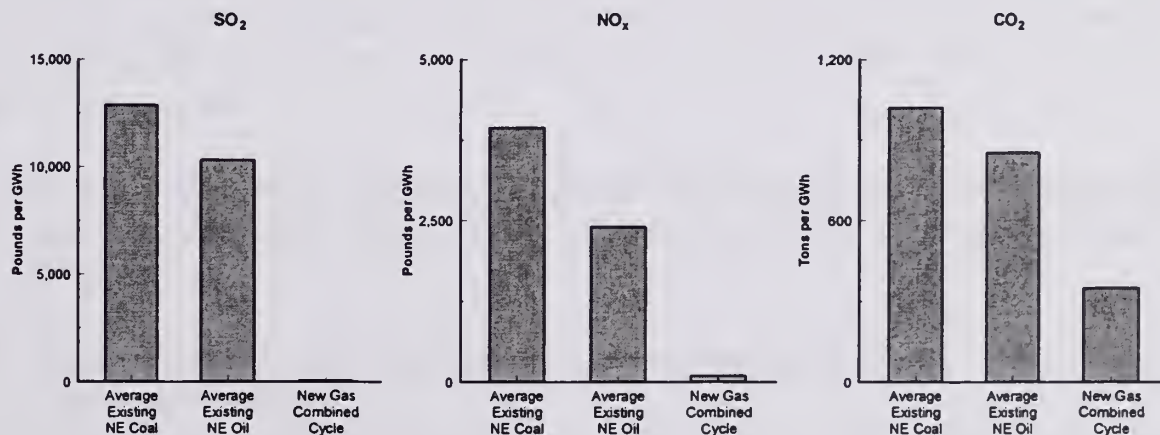


**Figure 6. New and Proposed Capacity in New England**



From an environmental perspective, it is important to note that CCGT produces significantly less pollutants than conventional generating plants as a result of lower emissions and greater operating efficiency. As demonstrated in Figure 7, CCGT releases 99.7 percent less sulfur dioxide (SO<sub>2</sub>), 93 percent less nitrogen oxide (NO<sub>x</sub>), and 28 percent less carbon dioxide (CO<sub>2</sub>) into the air than comparable coal-fired power plants. As existing generating facilities are displaced by CCGT, the level of greenhouse gases and other pollutants produced in the region will fall significantly.

**Figure 7. Emissions of CCGT compared to Coal and Oil-fired Power Plants**



Sources: USEPA 1997 Emissions Scorecard; 1997 EIA 767; PG&E Generating





The expected reductions in pollution from conventional power sources -- dominated by existing hydro and CCGT -- while certainly beneficial, may make it more difficult for wind and other renewable energy suppliers to attract customers. Suppliers of grid power generated through wind and other renewable resources will need to orient their marketing efforts toward informing consumers about carbon reduction, sustainability and fuel diversity in order to differentiate their products from energy generated from burning natural gas.

### ***2.2.7 The development of a sustainable green power market requires time and concerted action on multiple fronts.***

The green power market is unlikely to develop until fully functioning competitive markets are established. While the number of customers that elects to switch power suppliers is likely to increase in the next few years, major residential markets will be delayed until the standard offer approaches 5.0 cents per kWh, assuming that the wholesale price for electricity remains at roughly 3.5 cents per kWh. At that point, Massachusetts is likely to see the emergence of green power suppliers, offering pure and blended green products in efforts to be competitive with conventional power suppliers.

The development of the green power market will require actions affecting demand and supply. Green power suppliers need to be ready and prepared to launch aggressive marketing campaigns to compete for customers. These companies will naturally focus on segments of the market that are willing to pay a premium for energy generated from renewable resources. It is imperative that efforts to raise consumer awareness and secure their participation in green power programs be based on accurate and credible information, including the potential costs and benefits relative to conventional sources.

In addition, considerable attention will need to be devoted to developing or accessing *new* generating capacity in Massachusetts and other areas that are tied into the New England power grid. Siting, financing and other issues will need to be addressed in ways that protect community interests, benefit consumers and afford profitable returns to private investors. From the public's perspective, emphasis needs to be placed on securing most preferred renewable energy products at the lowest cost for those consumers in Massachusetts that are willing to pay more for green power.

## **2.3 Using renewable energy technologies in distributed generation shows bright promise in Massachusetts and elsewhere, but barriers exist to wide-scale adoption.**

### ***2.3.1 More attention is being focused on integrating renewable energy technologies into green buildings.***

Roughly one-third of all energy consumed in the U.S. is used for heating, cooling, lighting and appliances in buildings. As a result, considerable attention has been focused over the past three decades on enhancing energy efficiency within homes, offices, schools, hospitals and other buildings. Energy efficiency measures include a broad range of elements such as passive



solar design, tight construction, natural lighting and ventilation, improved landscaping, high levels of insulation, high performance windows and doors, as well as energy efficient heating and cooling systems, appliances and light fixtures. These approaches have been successful in reducing energy consumption at relatively low cost.

More recently, people have begun to take a more comprehensive view of the ecological impact of buildings, promoting pollution prevention, waste minimization, water conservation, and the greater use of natural and recycled materials. The concept of so-called “green buildings” can also include the incorporation of renewable energy technologies into buildings, particularly fuel cells and PV systems.<sup>37</sup>

In this regard, integrating PV modules into the skin of a building can reduce the effective cost of system installation. For example, PV modules are most commonly fabricated on glass substrates. These can be used to replace any laminated opaque or semi-transparent glass on the outside of a building, including curtain walls and/or skylights. Combined with energy savings, the substitution of PV modules for other building materials can reduce the net cost of the PV system to more economical levels. In this case, consumers may avoid the full cost of electricity (i.e., seven to 11 cents per kWh) that would otherwise have been purchased from energy suppliers.<sup>38</sup> In addition, incorporating PV systems into building design can provide intangible benefits, enhancing the appeal of the building and providing a visible testament to the environmental commitment of the developer.

Green building practices, including the use of renewable energy technologies, need to be considered at the start of the building design phase. Approaching renewable energy technologies as a building component, rather than simply as an alternative source of energy, requires architects and engineers to take a different approach to design. Moreover, special attention needs to be placed on building codes and zoning issues.

Limited awareness of green building practices among developers and architects, lack of hard technical and financial information, and high capital costs have constrained the development of this application of renewable energy technologies.

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<sup>37</sup> Donald W. Aitken, *Whole Buildings: An Integrating R&D and Policy Framework for the 21<sup>st</sup> Century*, Union of Concerned Scientists, October 1998.

<sup>38</sup> The magnitude of saving depends on existing rates as well as the manner in which metering and demand charges are structured.





### Union of Concerned Scientists

Location: Cambridge, Massachusetts  
Energy Type: Photovoltaic  
Generating Capacity: 2.1 kW  
Installation Date: 1994

The Union of Concerned Scientists installed the photovoltaic system as part of a redesign of the 30,000 square-foot six-story building that now serves as its national headquarters. The green building features a ballasted roof-top PV system that requires no roof penetrations.

The PV system offsets the electrical demand of office lighting, computers, and HVAC equipment.

Funding for the project was provided in part by Cambridge Electric, the Electric Research Institute, COM Electric, and several other foundations.

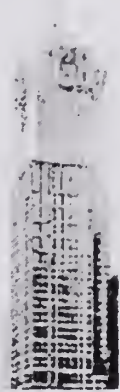


### 4 Times Square

Location: New York City  
Size: 1.6 million sq. ft.  
Architect: Fox & Fowle Architects  
Completed: September 1999  
Cost: \$500 million

The 48-story Conde Nast building located at 4 Times Square is one of the world's first environmentally conscious skyscrapers. In addition to embracing standards for energy efficiency, indoor air quality, and sustainable materials, the building uses fuel cells and thin-film photovoltaics to minimize peak load demand charges during the day and offset the electrical load of the building's Times Square signage at night.

The building has two rooftop fuel cells that generate approximately six million kWh annually as well as PV systems that are integrated into the southern and eastern facades on eleven floors of the building that generate an additional 48,000 kWh per year.



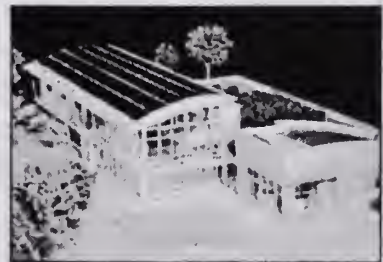
### Oberlin College: Adam J. Lewis Center for Environmental Studies

Location: Oberlin, Ohio  
Size: 13,600 sq. ft.  
Architect: William McDonough + Partners  
Completed: January 2000  
Cost: \$6.61 million

The Adam J. Lewis Center for Environmental Studies at Oberlin College has won architectural awards from the American Institute of Architects and the Chicago Athenaeum for its green building design. It is estimated that the building will use approximately 67,000 kWh, or 16,500 Btu/square foot/year. This represents 79 percent less energy consumption than a comparable classroom building built in the same area with traditional methods.

The building utilizes 3,700 square feet of photovoltaic panels mounted on a curved, south facing roof. These rooftop panels can be easily upgraded as new photovoltaic technology becomes available and it is expected that advancements in the next few years will allow the panels to exceed the building's total energy needs.

The building also employs closed-loop geothermal wells for heating and cooling, thermal floors and interior masonry for heat retention, south-facing UV-filtering windows for capturing sunlight and maintaining constant building temperature, and solar power for wastewater treatment. In addition, environmentally friendly building materials and furniture were used throughout the building. For example, the frame and roof are made of recycled materials, desks and chairs are made of wood from sustainable forests, and auditorium seating is biodegradable.





### **2.3.2 *There is significant opportunity to use renewable energy technologies to provide premium power for sensitive load and other applications requiring reliable power.***

While most customers consider cost to be the most important criterion affecting their purchasing decision, certain segments of the market are more concerned with the reliability of power, seeking to minimize surges, sags, or interruption. Growing concerns about power reliability is fueling demand for premium power systems.

When used in a particular configuration, fuel cells can provide a reliable source of power for sensitive loads. The benefits of the technology can be seen in the following example. Conventional grid power is available only 99 percent of the time, excluding outages under a minute as well as surges and swells in the power level. To prevent costly outages, data centers typically install uninterrupted power supply (UPS) systems, consisting of diesel generators and batteries. While these systems can boost reliability to 99.99 percent, this level of availability still implies up to 53 minutes of downtime a year. While appearing to be negligible, this amount of downtime can be enormously expensive: for a typical financial transaction processing company, one hour of downtime can translate into lost revenue of approximately \$7 million.<sup>39</sup> Fuel cell-based premium power systems offer higher reliability, with a promise of 99.9999 percent availability or roughly 0.5 minute of downtime per year, at a *net* cost roughly comparable to conventional UPS. As a result, they have the potential to capture a significant share of the \$1.2 billion worldwide annual market for conventional UPS.

Given the higher capital cost of fuel cell-based premium power systems, early adopters will likely be customers who place the highest marginal cost on power outages. Primary applications will be found in industries such as financial services, data center management, airline flight control, telecommunications, highly sensitive manufacturing operations (e.g., microchip fabrication), and medical facilities where outages can cause significant economic or other damage. An additional market segment may consist of public facilities where the social or political cost of outage justifies the use of fuel cell-based premium power systems. These facilities could include correctional facilities, schools and emergency shelters. Estimates suggest that there are on the order of 60 public facilities in Massachusetts with mission-critical power uses, representing a potential market for almost 30 megawatts of installed capacity.

While there are different types of fuel cell technologies, phosphoric acid (PAFC) is the only technology that is commercially available at this time and used in premium power systems currently on the market.<sup>40</sup> These systems use fuel cells manufactured by ONSI Corporation in South Windsor, Connecticut – part of the International Fuel Cell Division of United Technologies. ONSI has installed more than 200 PAFC units to date.

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<sup>39</sup> This estimate includes revenues lost during the outage, the cost of losing customers due to the outage, and the cost of re-acquiring those customers.

<sup>40</sup> There are three other types of fuel cells: proton exchange membrane (PEMFC), molten carbonate (MCFC), and solid oxide (SOFC). MCFCs are now being tested in full-scale demonstration plants. Offering higher fuel-to-electricity efficiencies, MCFCs operate at temperatures of around 650°C. SOFCs are currently being demonstrated in a 160-kilowatt plant. It represents the state-of-the-art, offering the potential for greater reliability and electrical efficiency. The fuel cells operate at up to 1,000°C.





However, there are other companies that are actively pursuing business and residential markets based on alternative fuel cell technologies, particularly Proton Exchange Membrane (PEM). These companies include International Fuel Cells, Ballard Power Systems, Plug Power, Toyota, General Motors, and H-Power. Closer to home, Dais-Analytic Corporation has developed a prototype fuel cell system for home use. The RPG-3K Residential Power Generator produces 3 kW, 120 VAC from natural gas or propane, peaking up to 10 kW using eight lead acid batteries. Testing is scheduled to begin this year. In addition, Epyx Corporation – a spin-off from Arthur D. Little – recently merged with De Nora Enterprises to develop PEM fuel cell systems for residential and automotive applications. The new company will go by the name of Nuvera Fuel Cells, with offices in Cambridge, Massachusetts and Milan, Italy.

PEM operates at ambient pressures and lower temperatures than PAFC. This has several potential advantages, including an ability to adjust to varying loads, simpler construction, less noise, less chance for fuel leakage and lower costs.<sup>41</sup> As a result, this technology may be attractive as means to supplement grid power. People who live in areas prone to power outages from hurricanes, ice storms, and floods may be interested in purchasing fuel cells for their homes.<sup>42</sup> However, they may have to wait a few years. Unlike PAFC, PEM fuel cells are still in development. Commercial units are not expected to hit the market for at least another one to two years.

Growth of the market for premium power systems is hampered by four principal factors:

- **Inadequate understanding of potential risks.** Potential customers are generally not aware of the potential risk that they face with respect to power sags, surges and outages. Few companies and institutions have undertaken a systematic analysis of their risks, placing a dollar value on potential power problems.
- **Lack of hard technical and cost data.** Customers must weigh potential gains in reliability against the cost of fuel cell-based premium power systems or conventional UPS. This assessment requires real operating data. Many potential customers will elect to wait until more information is available or seek guarantees of performance.
- **High capital costs.** The high initial capital cost of fuel cell-based premium power systems adds an element of financial risk to the decision and compounds the difficulty of the customer's purchase decision. This may require leasing the premium power system and selling premium power as a service, billing the capital cost of the system through its depreciation.
- **Technical constraints.** Newer fuel cell technologies such as PEM still face technical barriers related to the fuel cell stack and reformers. Most of the companies are still at the prototype stage with little or no field experience.

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<sup>41</sup> These characteristics also make the technology suitable for transportation applications.

<sup>42</sup> Consumers may also turn to PV technologies as a source for backup power.





### **First National Bank of Omaha**

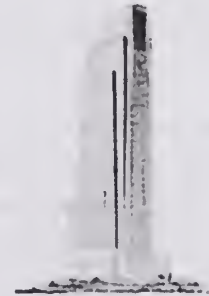
Location: Omaha, Nebraska  
Energy Type: Fuel Cell  
Generating Capacity: 800 kW  
Installation Date: June 1999  
Cost: \$3.4 million

The First National Bank of Omaha is the first major commercial facility in the United States to utilize high-availability fuel cell technology.

Produced by Sure Power of Danbury, CT using ONSI Corporation fuel cells, the natural gas fuel cell system is used as the primary power source for the bank's 200,000 square foot data center, which contains the bank's critical computer systems. It provides 99.9999 percent, or six nines, of availability, translating into only 0.31 to 3.18 seconds of downtime per year. Traditional UPS systems provide only three nines or 99.9 percent availability, and can experience up to an hour of downtime per year.

The system's four fuel cells convert natural gas into electricity, heat and water, producing 200kW of electricity each. The data center's critical systems are powered by two of the cells and the other two are usually used to power non-critical items such as lights. In the case of individual fuel cell failure, power is automatically diverted to critical systems and non-critical systems become powered by the grid.

Studies estimate this system produces 46 percent less carbon dioxide than a traditional UPS system, while producing no nitrogen oxide or sulfur dioxide. It also recovers 70 to 80 percent of the heat it generates, translating into approximately 700,000 Btu per hour. This heat can be used in the winter for space heating and to keep surrounding sidewalks clear of snow. Finally the bank is able to run the system at full capacity and sell any excess electricity back to the local utility company.



### **South County Hospital**

Location: Wakefield, Rhode Island  
Energy Type: Fuel Cell  
Generating Capacity: 200 kW  
Installation Date: December 1999  
Cost: \$600,000

The South County Hospital is the first hospital in New England to utilize fuel cells. The ten-foot by eighteen-foot system supplies one-third of the hospital's peak base load electricity requirements, 700,000 Btu's per hour of usable heat, and high-grade electricity for power-sensitive medical equipment such as CAT scanners. Since it is always on, the fuel cell system also provides immediate and reliable backup power to critical loads during power outages.

Hospital officials estimate that the system will save them \$60,000 to \$90,000 each year on energy bills. Funding for this project was partially provided by the Providence Energy Corporation, the Rhode Island Renewable Energy Collaborative, and the US Department of Energy.





### ***2.3.3 The deregulated environment is creating opportunities for using renewable energy technologies to enhance the local distribution system.***

Restructuring efforts, increased system constraints and technological advances are generating considerable interest among distribution companies in using renewable energy technologies to supplement local distribution systems. From the energy distributors perspective, substantial benefits may be derived from placing small-scale generation facilities where energy is needed as a way to defer or avoid costly upgrades to the distribution system.

Distributed generation can result in cost savings for distribution companies. Constraints can make expanding the existing centralized distribution network more costly in some cases than using distributed generation. While the average cost of centralized power generation, transmission and distribution is on the order of 2.5 cents per kWh, extending service to certain areas can run as high as 20 cents per kWh.<sup>43</sup> As a result, distributed generation based on renewable energy technologies may be cost effective in areas where distribution systems need to be installed, upgraded or replaced.

Distributed generation can also result in increased reliability for both the primary recipient of distributed generation power and traditionally grid connected customers in the same area. Some generally cited reasons for increased reliability include lower required power reserve margins, reduced transmission load on lines, and reduced power outages for traditional grid connected customers. Other benefits include combined heat and power generation (for primary users), reduced land impacts and reduced air, water and noise pollution.

### ***2.3.4 The market for renewable energy technologies as a source of low-cost energy in off-grid remote locations is growing rapidly.***

Renewable energy technologies can be cost-effective alternatives where central power generation is unavailable or the cost of connecting to the grid is prohibitive. For example, photovoltaic systems have long been used as a source of power for lighting, signage, and other applications in remote locations. These systems typically range in size from five to 1000 watts.

Annual sales of PV systems for remote applications total roughly \$66 million and are growing at approximately 20 percent per year. Participation by Massachusetts and New England-based PV firms is limited. A small number of local distributors and installers exist, playing in a regional market totaling \$1.3 million in annual revenue (Figure 8).

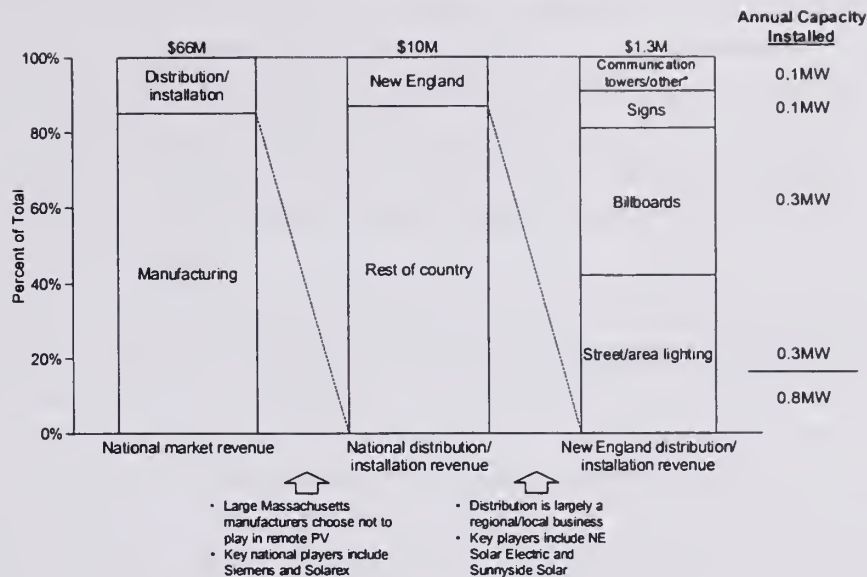
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<sup>43</sup> Moskowitz, David. Profit and Progress Through Distributed Resources, February 2000





**Figure 8. Remote PV Market**



\*Other includes vacation homes, water pumping, cathodic protection  
Source: Industry Interviews; Lucid; Motorola; Bain Analysis

## U.S. Coast Guard Buoys and Lighthouses



Since 1984, the US Coast Guard has converted approximately 16,000 of its navigational buoys and beacons from disposable batteries to PV-powered rechargeable batteries. According to Sandia National Laboratories, this conversion was saving the US Coast Guard an estimated \$2 million a year in maintenance costs and \$3 million in new battery costs as of 1991. The Coast Guard claims these savings have increased since then due to increases in battery disposal costs.

The Coast Guard has also begun converting its lighthouses from diesel generator or underwater cable power to photovoltaic power. This decision is purely an economic one, as diesel generators are maintenance intensive and expensive to fuel, whereas PV systems require maintenance only twice a year, battery replacement every ten years, and PV panel replacement every twenty years. Photovoltaic systems are also cheaper than replacing severed underwater cables.

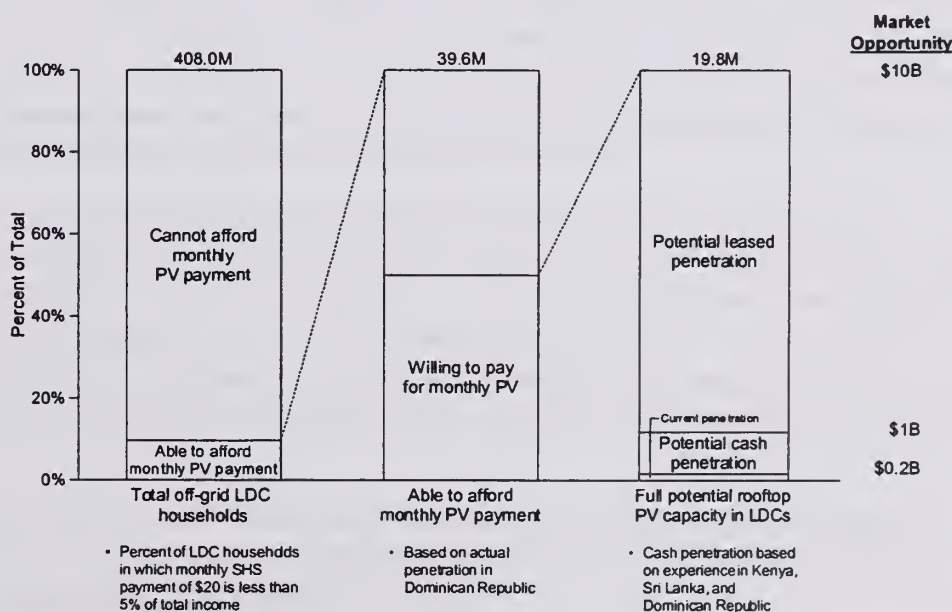




While the market for PV systems is growing, local distributors face a customer base that is largely unaware of the potential for using PV in remote applications. These distributors lack the resources required to increase customer awareness and mount broad marketing campaigns. Local manufacturers provide little support to the small, fragmented base of distributors. Most large PV equipment manufacturers are focused on profitable government-subsidized PV projects, and have not chosen to focus on commercializing remote PV applications. This would require a major redirection of internal resources and imply a very different business model than these companies currently employ.

While there is considerable potential for expanding the use of PV in remote applications in Massachusetts, there are greater business opportunities farther afield. In developing countries, where much of the population is not connected to the grid, small PV modules are a cost-effective option compared to alternative lighting sources such as candles, kerosene lamps, car batteries or small generators. At approximately \$3.34 per kilowatt-hour (kWh), PV systems are significantly less expensive than these alternative sources. The potential market for off-grid PV in developing countries is estimated at approximately \$10 billion (Figure 9). This calculation is based on estimates of household income, willingness to adopt PV technology, and assumed availability of lease financing or rentals for households unable to invest the capital required for outright purchase of a system. Companies that are interested in penetrating this market need to overcome significant hurdles, including establishing viable distribution channels and maintenance organizations.

**Figure 9. International Off-grid Rooftop PV Market**



Source: World Bank; Soluz; SDC; E&Co; Bain Analysis



#### **SOLUZ, Inc.**

SOLUZ, Inc., a Massachusetts-based corporation, is a pioneer in the electrification of remote areas in developing countries. The company is able to provide electricity at affordable monthly rents by maintaining ownership of its solar home systems (SHS). Rents range from US \$5 to \$20 per month, prices equivalent to that now paid for kerosene, dry cell batteries, and re-charging car batteries to power televisions. SOLUZ, Inc. has installed and is collecting fees on more than 1,000 solar home systems in the region of Puerto Plata, Dominican Republic and has secured capital to finance start-up operations for a similar venture in Honduras.



## **2.4 There is a small, but strong base of renewable energy companies and institutions in the Commonwealth with potential for significant growth.**

### **2.4.1 *Massachusetts is already home to a significant number of renewable energy companies.***

There are more than 100 companies in the Commonwealth that are involved in the renewable energy sector. Many of these companies are active in the PV arena including such firms as Crystal Systems and Spire Corporation which manufacture equipment used to produce PV cells and modules; ASE Americas, Inc., and Evergreen Solar which manufacture PV modules; Raytheon Systems Company which manufactures inverters; and Ascension Technology which designs and fabricates PV balance-of-systems equipment and monitoring instrumentation, and installs grid-connected photovoltaic power systems. In addition, there are a number of other companies in Massachusetts that provide design consulting, engineering, and installation services as well as distribute a variety of solar-related products.

While there are no companies in the Commonwealth that manufacture wind turbines, Massachusetts has firms that manufacture other equipment included in wind energy systems. For example, Second Wind, Inc., manufactures electronic monitoring and measuring systems for utility-grade wind power systems. Other firms in Massachusetts – such as TrueWind Solutions, and Brower and Company – provide wind mapping software and services. Moreover, there are several firms that assess, design, distribute, install and/or service wind energy systems.

There are also companies located in Massachusetts that are involved in the design and manufacture of fuel cells and stacks, components and test equipment. These include ElectroChem, Dais-Analytic, and Nuvera Fuel Cells.

Most renewable energy firms in Massachusetts are small, focusing on specific parts of the value added chain as illustrated in Table 7. Many of these companies face significant barriers, including limited staff resources, low capitalization, and difficulties accessing financial markets.





**Table 7. Value Added Chain in Selected Renewable Energy Technologies**

	Photovoltaics	Wind Turbines	Fuel Cells
<b>System integration, distribution and services</b>	<ul style="list-style-type: none"> <li>Integration of modules into system and field installation</li> </ul>	<ul style="list-style-type: none"> <li>Assembly of wind turbine (including towers) and installation of power collections and transmission system.</li> </ul>	<ul style="list-style-type: none"> <li>Consists primarily of installation of factory assembled systems</li> </ul>
<b>Specialized assemblies, components, and raw materials</b>	<ul style="list-style-type: none"> <li>PV cells / modules / panels</li> <li>Power electronics</li> <li>Inverters</li> <li>Batteries</li> <li>Off-spec polysilicon</li> <li>Cadmium and selenium (thin film)</li> <li>Mounting structure</li> <li>Primary metals and glass</li> <li>Wiring</li> </ul>	<ul style="list-style-type: none"> <li>Rotor (blade assembly)</li> <li>Gearboxes</li> <li>Brakes</li> <li>Generators</li> <li>Tower</li> <li>Anemometers</li> <li>Power electronics</li> <li>Inverters</li> <li>Primary metals</li> <li>Misc. metal parts</li> <li>Cables</li> <li>Wiring</li> </ul>	<ul style="list-style-type: none"> <li>Carbon graphite plates and membranes (PEMFC)</li> <li>Ceramic plates (SOFC)</li> <li>Reformers</li> <li>Power electronics</li> <li>Inverters</li> <li>Blowers and other air handling equipment</li> <li>Carbon fiber or metal hydride tanks for storing hydrogen</li> <li>Solid or liquid electrolyte, such as phosphoric acid or carbonate</li> <li>Platinum, nickel or other catalyst material</li> </ul>
<b>Other</b>	<ul style="list-style-type: none"> <li>PV manufacturing equipment</li> </ul>	<ul style="list-style-type: none"> <li>Resource assessment and mapping consultants</li> <li>Environmental service consultants</li> </ul>	<ul style="list-style-type: none"> <li>Engineering service consultants</li> </ul>
<b>Fuel feedstock</b>	<ul style="list-style-type: none"> <li>NA</li> </ul>	<ul style="list-style-type: none"> <li>NA</li> </ul>	<ul style="list-style-type: none"> <li>Gasoline, natural gas, plant material or plant-derived fluids such as methanol, etc.</li> </ul>



Massachusetts also has a strong base of research universities and colleges that are active in the field.

Massachusetts' colleges and universities are home to numerous faculty members active in the field of renewable energy as well as research centers that focus on issues related to biomass, fuel cells, photovoltaic, wind and other renewable energy technologies.

- While there is a great deal of research carried out at the Massachusetts Institute of Technology that is related to renewable energy, the University also has established two centers devoted specifically to energy research. The Energy Laboratory is a multidisciplinary center for research related to all forms of energy, including renewable energy. The Center for Energy and Environmental Research focuses on policy issues.
- The University of Massachusetts system includes a number of research centers related to renewable energy. These include the Center for Energy Efficiency and Renewable Energy, Center for Electric Car and Energy Conversion, and the Center for Sustainable Energy.
- Other engineering schools in Massachusetts have similar research programs. These include the Energy Technology Innovation project at Harvard University, the Power Electronics and Motion Control Systems Laboratory at Northeastern University, and the Center for Energy and Environmental Studies at Boston University.

These and other research institutes in the Commonwealth play an important role in advancing an understanding of the technical, economic and political issues related to renewable energy. They also provide the training grounds for individuals interested in pursuing careers in related fields.





### 3 Strategy for the Massachusetts Renewable Energy Trust Fund

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#### 3.1 The Trust will be used to advance the goals mandated in the legislation.

MTPC will aggressively promote the environmental, economic and other goals mandated in the Restructuring Act, taking steps to ensure that the interests of consumers in the Commonwealth are at the fore of any investment decision.

In keeping with its legislative mandate, MTPC will endeavor to use the Trust to achieve four related statutory objectives:

- Shift electric energy consumption in Massachusetts from conventional energy resources to a greater reliance on energy generated from renewable resources,
- Increase electric generating capacity from renewable resources to meet the growing energy demands of consumers in Massachusetts,
- Expand the renewable energy sector in Massachusetts, including system developers, manufacturers, equipment vendors, architects and engineers, service providers, and research organizations.
- Increase the overall level of economic activity related to renewable energy in the Commonwealth.

In pursuing these objectives, MTPC will strike an appropriate balance between achieving near-term impacts and helping the Commonwealth move toward a new energy paradigm.

#### 3.2 Investments from the Trust will be guided by a clear set of principles.

Investments undertaken to advance the goals articulated in the Restructuring Act will be based on certain underlying principles:

- **The Trust investments should build on consumer choice as reflected in a willingness to pay for electricity generated from renewable resources.** Sustainable, competitive markets require a willingness of consumers to pay the full costs associated with renewable energy. Consumers exercise choice directly through individual purchasing decisions based on the value that they derive from the good or service – the greater the expected benefit, the higher the willingness to pay. In certain distributed power generation applications, consumers may be willing to pay for renewable energy because it is actually less expensive (or higher quality) than conventional energy sources. In this case, consumer demand is driven primarily by financial considerations. However, evidence suggests that some consumers may be willing to pay a premium on their utility bills for green power or bear the additional costs associated with the use of renewable energy technologies in green building applications. In these instances, demand appears to be motivated, to a significant degree, by a desire to further the public interest. MTPC believes that the Trust should be used to capitalize on the willingness of some consumers to pay for renewable energy whether



motivated by financial considerations or broader public concerns. Investments in support of potentially sustainable markets will advance the public purposes stipulated in the Restructuring Act to a greater extent than those made without regard to the possible future direction of the market. MTPC will use the Trust to develop information on consumer preferences, test different approaches to developing sustainable markets, and support efforts designed to overcome barriers that currently limit potential demand, e.g., imperfect information and inadequate financing.

- **Ongoing subsidies for renewable energy should be clearly justified and used only to further the public interest.** It is important to acknowledge that public benefits from renewable energy are not fully reflected in the market. Some benefits afforded by renewable energy – air quality improvements, energy diversification, and broad economic advances – are essentially public goods whose value is *not* reflected in the market.<sup>44</sup> Moreover, increasing returns to scale or network externalities may lead to long-term reductions in the costs and/or an increase in the value of renewable energy technologies.<sup>45</sup> In either event, consumers may not purchase renewable energy on their own at levels deemed optimal from a societal perspective. Given the current price of electricity generated by conventional means, increasing consumption and generation of renewable energy beyond the level that can be supported based solely on a willingness to pay would require regulations (such as the proposed RPS) and/or a commitment to ongoing subsidies.<sup>46</sup> While MTPC is prepared to underwrite the cost of renewable energy to achieve its legislative mandate, it believes that a long-term commitment to such support must be based on a clear rationale, specific objectives, credible estimates of likely effectiveness and potential public returns, and broad backing from consumers and other stakeholders. In the absence of these elements, significant resources can be expended in the short-term without lasting impacts.

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<sup>44</sup> Public goods have two unique properties: First, consumption of a public good by one consumer does not affect the ability of other consumers to benefit from it (*non-rivalry*). Second, it is impossible to stop people from benefiting from the good even if they are unwilling to pay for it (*non-excludability*). The benefits ascribed to renewable energy meet both of these conditions. For the most part, customers that pay a premium for renewable energy receive the same benefits as every other consumer (and non-consumer). Customers that decide to pay a premium for renewable energy do enjoy, however, the additional satisfaction of contributing directly to the broader public interests.

<sup>45</sup> A market is characterized by increasing returns to scale when the price of producing an additional unit of a product (the marginal cost of the product) goes down as the quantity of the product produced goes up. Central power generation is an example of a market that exhibits increasing returns to scale. Most of the cost of providing electric power comes from constructing the facilities and building the distribution system. Once that infrastructure is in place, supplying more and more energy to consumers costs very little. Markets exhibit network externalities when the value of each unit of a product increases with each unit sold. For example, the value of owning a renewable energy system may increase as standards emerge for various aspects of their operations.

<sup>46</sup> It is important to note that the current price for electricity based on fossil fuels or fission materials does not reflect the social costs of pollution and other externalities. The current price for electricity would be higher if these costs were included.



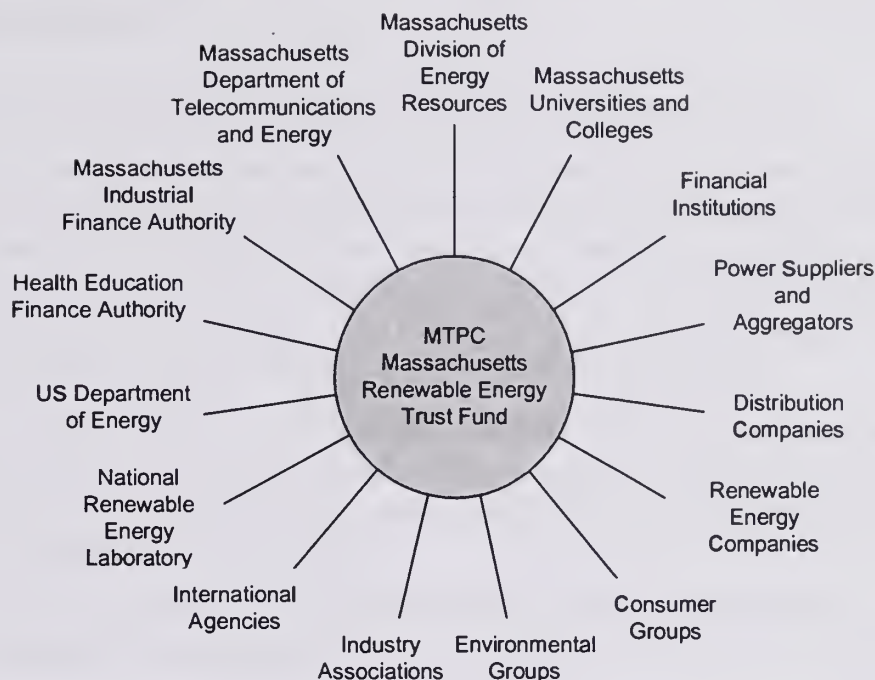


- **The Trust resources should be leveraged with investments by other private and public organizations.** MTPC believes that it is important to leverage resources available through other interested parties, including consumers, power suppliers, distribution companies, renewable energy firms, state and local agencies, the federal government and international organizations, foundations, and private investors. Financial leverage will extend the impact of the Trust, while also helping to ensure a strong commitment to specific projects and the broader goals of the Restructuring Act.
- **Investments from the Trust should be subject to systematic review based on explicit criteria.** MTPC believes that it is crucial to establish formal processes governing the use of the Trust to ensure fairness to stakeholders and proper accountability to the MTPC Board of Directors, the Governor and the Legislature. In particular, MTPC believes that major expenditures from the Trust should be subject to systematic review based on explicit criteria and under the direction of independent review panels created for this purpose. Input from individuals with demonstrated expertise in relevant areas is critical to informed decisions. Early involvement of objective experts can help planners recognize and avoid problems. A formal approval process will help ensure that expenditures are undertaken based solely on the merits of proposals.
- **MTPC should collaborate with stakeholders in designing and implementing specific initiatives undertaken through the Trust.** Moving toward a greater reliance on renewable energy will involve hard choices – people directly affected by alternative approaches must have input into the decision-making process. Moreover, implementation of initiatives to achieve the goals mandated in the statute will require the collective action of numerous constituencies in the Commonwealth. MTPC believes that collaboration with all stakeholders is essential to success given the complexity of issues and the evolving nature of energy markets in Massachusetts and elsewhere. As a public program, the Trust would profit from a greater public debate regarding renewable energy and potential public benefits. Collaboration is the hallmark of MTPC's approach to working effectively on issues that simultaneously affect the public's welfare and private interests. The organization is convinced that new forms of public-private partnerships are essential to success. Wherever possible, MTPC will actively seek partners in the Commonwealth and elsewhere. It will encourage collaboration among consumers, renewable energy companies, distribution companies, power suppliers, universities, government agencies and other institutions as illustrated in Figure 10. In so doing, MTPC will maximize the impact of its investments by leveraging the resources and expertise of others in both the public and private sectors wherever possible.





**Figure 10. Potential Partners**



- MTPC should emphasize learning by doing.** No one knows precisely how markets for electricity from renewable sources will evolve and grow. A competitive energy market based on consumer choice is just getting off the ground in Massachusetts and elsewhere. Moreover, technological advances emanating from companies, universities and other research organizations are giving rise to the potential for wholly new products and associated markets. To a great extent, MTPC is charged with the task of helping to develop markets that either are in the earliest stages of development or do not exist at all. Because the path to a future based on a greater reliance on renewable energy resources is uncertain, MTPC believes that an ability to test assumptions and learn from actual experience will be critical to its success. This has three important implications. First, MTPC will experiment. This is not just about trial and error. An experimental approach requires well-articulated hypotheses, clear designs, documented processes and sound analysis. MTPC will be deliberative, taking steps to ensure that it is in a position to discover factors that contribute to success. Second, MTPC will conserve resources. MTPC will avoid committing the Trust to a single course too quickly, ensuring that it will have resources needed to adapt its strategy as markets evolve and lessons emerge. Third, in a relative vein, MTPC will establish a diverse portfolio of initiatives and programs, reflecting a variety of renewable energy technologies and applications.



### 3.3 The initial strategy will focus on five major initiatives.

MTPC will use the Trust to support five major initiatives designed to achieve the goals mandated by the legislation.

#### 3.3.1 *Support the development of distributed power generation projects.*

MTPC will use the Trust to accelerate the application of renewable energy technologies for distributed power generation in the Commonwealth. MTPC believes that there are significant opportunities in this market segment, but that limited awareness among potential customers, the absence of hard data on actual field performance, and high capital costs pose significant constraints. Assuming that the constraints can be overcome, MTPC believes that these applications of renewable energy technologies could be commercially viable.

Given the technical characteristics and economics of different technologies, this strategy will focus on expanding the use of fuel cells and photovoltaic systems in premium power, green building, utility and off-grid applications. However, all legally permissible renewable energy technologies will be eligible for consideration.

The initiative will provide information, financing and technical assistance needed to promote the development of projects in Massachusetts:

- **Provide project financing.** MTPC will draw on the Trust to finance carefully selected projects in the Commonwealth. Financing will be made available on a competitive basis for different aspects of proposed projects, including initial conceptualization, feasibility assessments, design and engineering, and system installation. Financing for planning studies (the first three items) will be provided on a cost-shared basis. To reduce the risk for commercial projects, the share provided by MTPC will be reimbursable only if a project goes forward. Every effort will be made to respond to requests for assistance as quickly as possible, while still maintaining adequate accountability.

Financing for the actual installation of systems will be structured as loans, loan guarantees or grants depending on the particular needs of the project. All requests for financing of system installations will be subject to systematic review based on at least six criteria:

- **Potential public benefits.** Projects will be judged on the degree to which they are likely to contribute to the goals delineated in the statute and otherwise serve the public interest. To this end, where appropriate, preference will be given to projects located in Massachusetts and renewable energy technologies that are manufactured in the state.
- **Net cost per kWh.** MTPC will consider the projected net cost per kWh of the system. The net cost will be estimated based on the annualized total system costs, accounting for potential energy savings and other benefits with the intention of supporting the lowest cost alternative.
- **Commercial potential.** It is assumed that most of the applications of renewable energy technologies in this market segment have the potential to be cost-effective from a





financial perspective. Projects will, therefore, be judged on the degree to which they advance the commercial prospects of the underlying technology.

- **Geographic location.** The Trust is intended to benefit consumers throughout the Commonwealth. Therefore, MTPC will strive to support projects in all parts of Massachusetts.
- **Leverage of the Trust financing.** MTPC will consider the strength of the financial obligations of other parties involved in the project. Financial leverage is important to demonstrate commitment, validate commercial potential, and maximize the impact of the Trust.
- **Contribution to public debate.** Increased awareness of renewable energy applications and their relative costs and benefits are essential to the success of the Trust. In the case of public facilities, visible and innovative projects that are the product of a sustained public debate will receive particular consideration.

While MTPC will respond to unsolicited requests for financing, the organization plans to issue formal solicitations at regular intervals throughout the year. Unless special circumstances warrant otherwise, unsolicited requests will be reviewed during regular funding cycles.

- **Provide technical assistance.** To the extent practicable and where appropriate, MTPC will work with project developers and others to assist in negotiating favorable terms with system providers with respect to purchasing, installation, warranties, insurance, maintenance, and management and operating agreements. MTPC will also help make sure that projects capitalize on funding available through the federal government as well as federal and state tax incentives. In addition, the organization may help project developers and others deal with issues related to building codes and zoning regulations that may hinder the development of specific projects. In each instance, MTPC will assess the appropriate role of the organization and take appropriate action to overcome barriers to the development of proposed projects.
- **Monitor and evaluate outcomes.** Given the importance of providing hard data on actual performance, MTPC will undertake independent assessment of actual system performance, including net benefits to end-use customers. The results of these studies will be broadly disseminated and used as the basis for future actions.
- **Build awareness.** Providing information on the *potential* of fuel cells and photovoltaic systems in distributed power generation is a critical first step in encouraging consumers to adopt this technology in factories, offices, schools, hospitals, residences and other sites in Massachusetts. Based on demonstrated results, MTPC will work with interested parties to mount a campaign to provide needed information to consumers. The campaign will be directed primarily to architects, engineers, real estate developers and facility managers in both the private and public sector. This will involve a combination of meetings, seminars, workshops, conferences, and print and electronic media.



In keeping with the aims of this initiative, MTPC will develop its campus in Westborough to enhance energy efficiency and incorporate the best use of available renewable energy technologies. In addition to satisfying the organization's own energy needs and serving as a test-bed for new renewable energy technologies, this effort will showcase green building concepts to a broad local, national and international audience. In this regard, MTPC intends to host various meetings, workshops, seminars and conferences at its facilities in Westborough throughout the year.

While developing its campus as a living laboratory and demonstration of the utilization of renewable technologies and energy efficiency, MTPC will also be a center for renewable energy policy and thought. MTPC will draw technologists, policy-makers, entrepreneurs, investors and educators from across the country and the world to discuss current experiences, best practices and scientific breakthroughs which might enhance an understanding of the potential for generating electricity from renewable resources and provoke further deployment of renewable energy technologies. Similarly, MTPC will use its campus to convene teachers and students to observe and learn firsthand from experts about the impact of renewable energy technology on the environment and the economy.

### ***3.3.2 Support the development of the green power market.***

MTPC will assume an active role in bringing together all stakeholders and interested parties to build consensus on actions needed to promote the establishment of a green power market that best serves public interests in Massachusetts. The willingness of even a small portion of consumers to pay more for renewable energy could substantially advance the public purpose of increasing the Commonwealth's reliance on renewable energy sources to meet its electricity needs. In accordance, the initiative will focus on increasing demand for renewable energy among consumers that are willing to pay a premium for electricity generated from renewable resources and assuring the development of *new* generating facilities that employ cost-effective renewable energy technologies. Efforts will center on crafting market-based solutions that serve the interests of consumers in the Commonwealth

However, as yet, there is no clear best path for promoting the development of a sustainable green power market in the Commonwealth based on consumer choice. Therefore, the initiative will concentrate on research and planning efforts in the near term. Given the current situation, it appears neither prudent, nor in keeping with an emphasis on sustainability, to pursue a more aggressive approach involving consumer credits or otherwise buying down the cost of renewable energy for green power applications at this time. In the absence of a fully functioning competitive energy market and clear plans for developing *new* generating capacity from renewable resources, subsidies of this nature are unlikely to be effective in terms of meeting the goals articulated in the statute.

MTPC will work with stakeholders to frame issues related to the green power market and take specific action to test the viability of this market, investigate approaches that merit further attention, and encourage its development in the Commonwealth. In this regard, the organization anticipates undertaking the following activities:





- **Explore different ways to tap the apparent willingness of some consumers to pay more for energy from renewable resources.** The current preferred approach appears to center on premium pricing – for-profit electricity suppliers charging consumers a premium on their monthly bills for electricity produced from renewable resources. However, other options may be preferable or could complement this approach, including purchasing and production cooperatives that provide an at-cost green power alternative to consumers, social investment bonds, and charitable trusts. With regard to the latter, because of the public goods nature of the green power, purchases may be amenable to a favorable treatment under existing federal income tax law. Specifically, it may be possible to structure the purchase of green power from an energy supplier as a charitable contribution, enabling the consumer to take a deduction for the green power premium (the excess paid over the charge for conventional system power) on the federal income taxes. This would reduce the effective price paid by the consumer who itemizes deductions (up to 39.6% of the premium), inducing greater demand. If a tax deduction exists, it should be made available as a choice to consumers in Massachusetts. In this regard, MTPC intends to seek the required ruling from the Internal Revenue Service. Working with other stakeholders, MTPC will assess the relative merits of different approaches and help implement preferred solutions.
- **Collaborate with aggregators to develop renewable energy products for their members.** Existing and potential aggregators such as HEFA, MHTC, Cape Light Compact and communities served by MLPs are likely to be in the vanguard of the development of the green power market in Massachusetts. MTPC will work with these organizations to gauge potential interest in renewable energy among members and help negotiate appropriate service offerings with energy suppliers. This approach is likely to be more effective, particularly in the near term, in boosting demand for energy from renewable resources than mass advertising campaigns directed toward the public at large.
- **Explore the potential for purchases of green power in the Commonwealth by public agencies.** State and local government in Massachusetts spend a significant amount on electricity each year. Given the public benefits of renewable energy, government agencies must take an active lead in supporting the development of the renewable energy market through direct purchases of green power. MTPC will meet with government officials to encourage the purchase of green power and help negotiate appropriate service offerings with energy suppliers.
- **Document specific opportunities to develop wind projects in Massachusetts and other parts of the region.** The prospects for establishing *new* generating capacity hinges to a significant degree on the potential to develop wind resources. To proceed in this direction, it is imperative to understand the real prospects for installing wind turbines in different parts of Massachusetts and specific factors that limit particular projects. MTPC will undertake studies of potential wind projects (including mapping and technical analyses of wind resources). The organization will also work with developers and community representatives to address siting and other issues that pose barriers to potential projects.





- **Investigate mechanisms to finance large-scale wind projects.** Large wind projects require firm commitments and substantial investments. Working with financial institutions and other stakeholders, MTPC will examine and develop alternative financing mechanisms such as equity investments, bridge loans, and loan guarantees and that can be used to support projects in the Commonwealth and other parts of New England, where benefits inure to consumers in Massachusetts.
- **Encourage the adoption of government policies and regulations favorable to the growth of the green power market.** MTPC will actively participate in deliberations concerning settlement and disclosure rules, renewable portfolio standard, net metering, product certification, and other regulations affecting the green power market.

### ***3.3.3 Promote the development of the renewable energy sector.***

MTPC will use the Trust to undertake initiatives designed to strengthen the capacity and promote the growth of companies, universities and other organizations that are involved in the renewable energy sector in Massachusetts. While the current renewable energy industry centers on companies that build and install PV systems, it also extends to developers of fuel cells, manufacturers of specialized equipment, subassemblies, components, and commodity materials as well as engineering, architectural and financial services. Moreover, the Commonwealth is home to universities engaged in research that is important to the future development of the industry. MTPC believes that collective actions can help companies and institutions reap greater benefits from growing markets in Massachusetts and the rest of the world. The strategy will focus on bringing different organizations together to address common needs and take advantage of opportunities afforded by restructuring and changing market conditions. However, where appropriate, MTPC will also help deal with the concerns of particular enterprises.

MTPC will work with the renewable energy companies and institutions to identify and address needs that limit their ability to grow and succeed in the Commonwealth. While specific programs will be developed over time in response to expressed demand, it is anticipated that this may include activities in the following areas:

- **Help renewable energy companies capture a share of growing export opportunities.** There are significant business opportunities in other countries, particularly in developing nations, for manufacturers and distributors of photovoltaic systems and other renewable energy technologies. MTPC will work with existing companies in Massachusetts to identify opportunities in international markets and identify constraints that limit their success. In addition to providing information on new markets, MTPC will help forge relationships between companies in the Commonwealth and international institutions that are spearheading efforts to develop renewable energy projects in Africa, Latin America, Asia and elsewhere. This is likely to include organizations such as the Renewable Energy and Energy Efficiency Fund (REEF) and the Solar Development Group of the International Finance Corporation. In pursuing this activity, MTPC will strive to ensure that the citizens of



the Commonwealth reap the economic benefits from greater success of private firms in international markets.

- **Establish business-to-business networks.** The value chain in the renewable energy industry extends from manufacturers of commodity materials to systems integrators and distributors. MTPC will help suppliers of intermediate goods (e.g., raw materials, generators, inverters, batteries, power electronics, wiring, and various parts and sub-assemblies) market their products to system developers. In addition, it will take steps to help expand the network of companies engaged in the distribution, installation and maintenance of systems that employ renewable energy technologies in the Commonwealth.
- **Promote cooperative R&D efforts.** The Commonwealth's research universities play an important role in advancing technological progress in fields related to renewable energy. MTPC will support cooperative research and development activities in private and public universities throughout Massachusetts. This could center on addressing business and technological barriers to the widespread commercialization of renewable energy technologies in both central and distributed power generation. This will be done, in conjunction with companies, to help ensure that the research agenda focuses on issues of paramount concern to industry. Moreover, MTPC will help institutions secure a significant share of available federal funding, leveraging investments from the Trust.
- **Explore potential for establishing a renewable energy investment fund.** A significant percentage of renewable energy companies are quite small and lack needed capital for expansion. MTPC will investigate the need for establishing an investment fund targeted toward these companies with potential co-investors, including mutual funds, pension funds, banks, and other commercial lending institutions. MTPC considers this process important because it believes that leveraging private capital is essential to sustainable, competitive markets. It will consider different ways in which such a fund could be structured and managed. In the near-term, MTPC will work with the Massachusetts Technology Development Corporation to respond to investment opportunities in the Commonwealth.
- **Establish and work with industry-led collaborative organizations.** Collaborative efforts among enterprise and institutions in the Commonwealth can help to identify problems and opportunities within certain industries and to develop an appropriate course of action. In this regard, MTPC will explore the potential for establishing an industry association for companies involved in the fuel cell business, including potential customers, manufacturers of fuel stacks, plates, electrolytes, catalyst material, reformers, power electronics, inverters, blowers and other air handling equipment, and storage tanks as well as system installers and maintenance companies. Modeled after the successful MassMEDIC, the Council would serve to advance the interest of the industry through collaborative efforts. As part of this effort, MTPC will help formulate particular approaches that the State should take to encourage the development of a fuel cell industry in the Commonwealth. In so doing, it will seek to develop a comprehensive strategy that maximizes the economic development potential in Massachusetts resulting from the expected growth in this market.





### **3.3.4 Provide support to educational institutions for renewable energy programs.**

In addition to supporting the use of renewable energy technologies in schools, MTPC will also promote the incorporation of renewable energy science curricula in primary and secondary schools in Massachusetts and establish a scholarship fund for advanced studies in fields related to renewable energy. Educational programs may encourage students to pursue advanced studies in colleges and universities in Massachusetts, helping to fuel further research and meet future labor requirements in the renewable energy industry.

MTPC will actively encourage the integration of renewable energy topics into the existing Massachusetts Curriculum Frameworks. General information on renewable energy, specific lesson plans, suggested science experiments, and ideas for class and individual projects already exist for each grade level. MTPC will work with educators and other stakeholders to identify and review what is currently available and help teachers throughout the Commonwealth incorporate appropriate curriculum in their classrooms. Trust funding might be used for curriculum development, teacher training, purchase of classroom equipment and materials, and statewide student fairs and/or competitions.

To enhance the scholarship program for Massachusetts' students who choose to attend universities in the Commonwealth and pursue studies related to renewable energy, MTPC will work with companies in the area to secure internships for these students to reinforce academic instruction and help position them for careers in the field.

#### **Solar Solutions for Schools**

Locations in Massachusetts:  
Pickering Junior High (Lynn)  
McCarthy Middle School (Chelmsford)  
Pentucket Regional High School  
(West Newbury)

Energy Type: Photovoltaic  
Generating Capacity: 2kW - 4kW  
Installation Date: 1997



These three high schools each host photovoltaic systems as part of the Solar Solutions for Schools program administered by Solar Now, a non-profit program based at the Beverly High School. The systems feed directly into the Massachusetts Electric power grid, and do not provide any direct power to the schools. However, they are used for student education in the classrooms and for research pertaining to inclusion of PV in the power mix by Massachusetts Electric.



### 3.3.5 Pursue special opportunities.

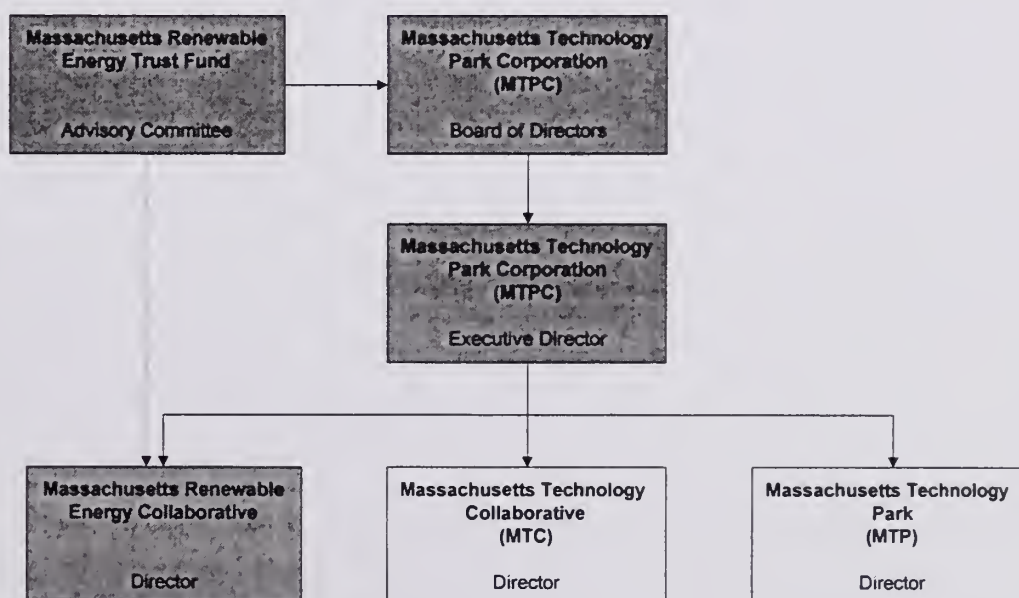
Given the rapid evolution of energy markets and enabling technologies, MTPC will seek to identify and support new opportunities that further the goals articulated in the legislation. This may include the establishment of a Center for Renewable Energy on the MTPC campus in Westborough and large-scale demonstration sites for advanced renewable energy technologies, and incentives to attract major renewable energy companies to the State.

Moreover, as warranted, MTPC may devote resources to major demonstrations of emerging renewable energy technologies such as advanced biomass, solar thermal, wave and tidal, and ocean thermal as well as advanced storage and conversion technologies.

### 3.4 The governance structure of the MTPC and the Trust will ensure that the views of a broad range of constituencies will be heard.

The Legislature recognized that the MTPC was particularly well placed to administer the Trust given its existing charter, public-private Board composition, broad statutory powers, and proven track record. As shown in Figure 11, the MTPC Board of Directors will oversee the Trust. The Board of Directors consists of senior managers from industry, universities, and state government. The Board includes the Chairperson of the Board of Higher Education, Director of the Massachusetts Department of Economic Development and the Secretary of the Executive Office for Administration and Finance.

Figure 11. Governance and Management





Pursuant to the enabling statute, the Governor has appointed an Advisory Committee of individuals from nominations submitted by the Chairperson of the MTPC Board of Directors to provide policy advice with respect to the Trust. The Advisory Committee consists of individuals with knowledge and experience in matters related to renewable energy, economics, finance, consumer affairs, education, and other relevant areas.

MTPC has established a new operating division – the Massachusetts Renewable Energy Collaborative (MREC) – to manage all initiatives associated with the Trust. The division will include a small professional and administrative staff with suitable background and skills. Core administrative functions including information systems management, financial administration, and legal counsel will be provided by MTPC as part of its ongoing corporate responsibilities. The division will draw on consultants and other organizations to undertake specific activities on a contract basis, supplementing internal capabilities without incurring the costs of building and maintaining a large, permanent staff.

MTPC also plans to establish a number of review panels to support various initiatives. In particular, MTPC will convene experts in requisite fields to undertake independent, systematic reviews of major funding proposals submitted by other organizations under different initiatives. Panel members will provide an objective assessment of the merits of individual proposals and identify areas warranting further elaboration and/or modification. Final approval for funding decisions will, however, rest with the MTPC Board of Directors.







